

REPORT
OF THE
INDIAN SURVEY COMMITTEE,
1904-05.

PART II.—APPENDICES.



CALCUTTA :
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1905.

CALCUTTA:
GOVERNMENT OF INDIA CENTRAL PRINTING OFFICE,
2, HASTINGS STREET.

TABLE OF CONTENTS OF PART II.

SECTION I.

Particulars of the receipts and disbursements of the Department and States of India with estimates of the milled and cost of bringing the topographical maps up to date or preparing new maps.

MADRAS.		Page
1. Field survey work		1
2. Surveyors and assistants employed		10
3. Value of Madras revenue survey maps		2
4. The Native States		3
5. Locally prepared maps		3
6. Estimate for producing new topographical maps		4
MYSORE.		
7. Previous survey		5
8. State of the maps		10
9. Expenses required		5
10. Locally prepared maps		11
CANARA.		
11. Previous survey		15
12. State of the maps		15
13. Estimate for new survey		15
HYDERABAD.		
14. Previous survey		16
15. State of the maps		16
16. Locally prepared maps		16
17. Estimate for new survey		16
BOMBAY.		
18. New survey already commenced		17
19. State of the maps		17
20. Locally prepared maps		17
21. Estimate for new survey		17
CENTRAL PROVINCES.		
22. Central Provinces not visited by C. and P.		17
23. Previous surveys		17
24. State of the maps		17
25. Expenses now required		18
26. Locally prepared maps		19
BHOJAR.		
27. Previous survey		19
28. State of the maps		19
29. Expenses required		19
30. Locally prepared maps		19
31. Small scale maps		19
SINDH.		
32. Previous survey		19
33. Topographical survey now in progress		19
34. Work now doing to be done		11
35. Locally prepared maps		19
36. Atlas sheets		19

BALUCHISTAN.

Para.	Page.
37. Existing maps	11
38. Work remaining to be done	12

CENTRAL INDIA AND RAJPUTANA.

39. Central India not visited by the Committee	<i>ib.</i>
40. Existing maps	<i>ib.</i>
41. Previous surveys	13
42. Estimate for new survey and re-survey	<i>ib.</i>
43. Locally prepared maps	<i>ib.</i>

PUNJAB.

44. Preliminary	<i>ib.</i>
45. Early surveys	14
46. Work of the Punjab Traverse Party	15
47. Recent supplementary survey	16
48. Cadastral material available for supplementary survey	<i>ib.</i>
49. Re-survey required	17
50. Revision required	18
51. Survey work in the Himalayas	<i>ib.</i>
52. Summary of requirements	<i>ib.</i>
53. Special and locally prepared maps	19
54. District maps	<i>ib.</i>

NORTH-WEST FRONTIER PROVINCE.

55. Composition of Province	<i>ib.</i>
56. Previous surveys	20
57. Cadastral mapping	<i>ib.</i>
58. State of the maps	<i>ib.</i>
59. Estimate for re-survey required	21
60. Trans-border territory	<i>ib.</i>
61. Locally prepared maps	<i>ib.</i>

KASHMIR.

62. Early surveys	22
63. Recent surveys	<i>ib.</i>
64. Survey requirements	<i>ib.</i>

UNITED PROVINCES OF AGRA AND OUDH.

65. Preliminary	23
66. Recent surveys	<i>ib.</i>
67. New survey required	<i>ib.</i>
68. Re-survey required in the plains	<i>ib.</i>
69. Re-survey required in the hills	<i>ib.</i>
70. Supplementary survey required	24
71. Revision required	<i>ib.</i>
72. Estimate of cost	25
73. Locally prepared maps	<i>ib.</i>

BENGAL.

74. Obsolete character of maps	26
75. Four-inch revenue maps	<i>ib.</i>
76. One-inch maps in Belur	27
77. One-inch maps in Central and Eastern Bengal and Orissa	<i>ib.</i>
78. Supplementary survey sufficient in above tracts	<i>ib.</i>
79. One-inch maps in Chota Nagpur and Tributary mahals	28
80. Re-survey unnecessary	<i>ib.</i>
81. One-inch maps in other hilly tracts	<i>ib.</i>
82. Requirements of officers consulted	29
83. Work to be done in Bengal	<i>ib.</i>
84. Estimate of cost	30
85. Work not urgent	<i>ib.</i>
86. Small scale maps	<i>ib.</i>

ASSAM.

Para.	Page.
87. Previous surveys	31
88. State of the maps	ib.
89. New maps required	32
90. Order of urgency of the work	33
91. Estimate of cost	ib.
92. Village boundaries	34
93. Locally prepared maps	ib.

BURMA.

94. Early surveys	ib.
95. Degree sheets	ib.
96. Small scale maps	ib.
97. One-inch maps	33
98. State of the maps	ib.
99. Suggestions regarding the maps	36
100. Work remaining to be done in Burma	ib.
101. Estimate of cost	ib.
102. Locally prepared maps	37

ANDAMANS AND NICOBAR ISLANDS.

103. Previous survey	ib.
104. Nature of survey work in the Islands	38
105. Survey requirements	ib.

SECTION II.

Statements by Members of the Committee.

I. Colonel Sir John Faguelarson, K.C.B., R.E. (retired), late Director-General, Ordnance Survey in England (English returns and estimates of cost for copper engraving appended)	41
II. Colonel F. H. Kelly, Assistant Adjutant-General, Military Member of the Committee	62
III. Colonel F. C. Grant, C.M.G., R.E. (with his letter dated Ordnance Survey Office, Southampton, March 27th, and estimates for lithography and photo-engraving appended)	67

SECTION III.

Selected Evidence (Survey of India Officers).

Colonel J. B. Hobday, I.A., Officiating Surveyor-General of India (work returns appended)	78
Lieutenant-Colonel F. H. Long, R.E., Surveyor-General of India, and Member, Indian Survey Committee	93
Major W. J. Byrdell, R.E., Assistant Surveyor-General, in charge Drawing, Engraving and Map Room and Issue Office, Headquarters, Calcutta	103
Mr. T. A. Page, Assistant Surveyor-General, in charge Lithography and Lithographic Office, Headquarters, Calcutta	113
Lieut. Lieutenant-Colonel T. P. B. Banny-Talboys, R.E., Assistant Surveyor-General, in charge Mathematical Instrument Office	122
Lieutenant-Colonel S. G. Burnett, F.R.S., R.E., Superintendent, Trigonometrical Survey	128
Mr. J. Foster, M.A., Superintended, 2nd grade, in charge Computing party	130
Major P. J. Gordon, I.A., Officiating Superintendent, 2nd grade, Superintendent of Forest Surveys	131
Major R. T. Crockett, I.A., Superintendent, Pargal Provincial Surveys	135

SECTION IV.

Selected Evidence (Public Works Department Officers at Government of India Headquarters).

Para.	Page.
Mr. S. Preston, C.I.E., A.M.I.C.E., Secretary to the Government of India, Public Works Department, Irrigation, Roads, and Buildings, and Telegraphs	140
Mr. C. W. Hodson, M.I.C.E., Officiating Secretary to the Government of India, Public Works Department, Railway Branch	142
Mr. E. I. Shadbolt, M.I.C.E., Officiating Director of Railway Construction	143
Mr. F. R. Upcott, C.S.I., Chairman, Railway Board	143

SECTION V.

Selected Evidence (Forest Officers).

Mr. S. Eardley-Wilmot, Inspector-General of Forests in India	145
Mr. T. B. Fry, Conservator of Forests, Central Circle, Bombay	145
Mr. E. D. M. Hooper, Conservator, 1st grade, Madras	146
Mr. F. Beadon Bryant, Conservator of Forests, Southern Circle, Burma	

SECTION VI.

List of questions regarding topographical maps issued by the Committee, preliminary to their enquiries, and selected answers.

Series I. For representatives of Local Governments	147
Series II. For Civil Officers	148
Series III. For Public and Military Works Officers	148
Series IV. For Military Officers.	149
Madras	150
Mysore	152
Coorg	152
Central Provinces	153
Bombay	157
Sind	162
Punjab	162
United Provinces of Agra and Oudh	171
Bengal	175
Barma (with a note by the Lieutenant-Governor on some points connected with maps in Burma)	179

SECTION VII.

Miscellaneous Papers.

Momorandum of a discussion at Hyderabad on 21st January 1905	183
Note of opinion expressed by the Honourable Mr. Fuller, C.S.I., Chief Commissioner of Assam	184
Letters received from officers serving in the North-West Frontier Province regarding the preliminary report of the Departmental Committee on topographical maps	186
Opinions of Local Governments regarding the decentralisation schemes put forward by Colonel Gore and Lieutenant-Colonel Longo, Surveyors-General of India	192
Opinions of Heads of European Schools on the rules for admission to the Provincial Service	197
An account of the scientific work of the Survey of India, and a comparison of its progress with that of foreign surveys, prepared for the use of the Survey Committee, 1905, by Lieutenant-Colonel S. G. Barrard, R.E., F.R.S., Superintendent of Trigonometrical Surveys	203
Note by Captain W. M. Coldstream, R.E., on the standard sheets of the United Provinces to be used as introduction to register of standard sheets	218

INDEX MAPS TO THE STANDARD SHEETS.

1. Madras, Mysore, and Coorg	To face page	4
2. Central Provinces and Berar	" " "	7
3. Bombay	" " "	9
4. Sind	" " "	11
5. Central India and Rajputana	" " "	13
6. Punjab and North-West Frontier Provinces	" " "	19
7. United Provinces of Agra and Oudh	" " "	25
8. Bengal	" " "	30
9. Assam	" " "	33
10. Burma, Upper	" " "	37
11. Burma, Lower	" " "	<i>ib.</i>

REPORT
OF THE
INDIAN SURVEY COMMITTEE.
1904-1905.

PART II.

SECTION I.

Description of the maps and surveys of the Provinces and States of India, with estimates of the method and cost of bringing the topographical maps up to date or preparing new maps.

MADRAS.

1. Very complete accounts of the history and methods of the Survey Department in Madras are to be found in the Chapter on "System of Survey" in the Administration Report of the Presidency for 1901-02, and in the Manual of the Administration, Volume I, Chapter II, page 96. It was in Madras, as already stated in Chapter II of Part I of this report, that the first sustained attempts were made both to place survey work on a scientific basis, and to conduct regular topographical surveys. The Presidency has always had a separate Survey Department of its own; but no regular revenue survey was instituted till 1855. The necessity for such a survey had for some time engaged the attention of the Government, and when proposals on the subject were made, the Surveyor-General of India strongly represented that no general survey should be undertaken without complete arrangements for making the materials subservient to the general purposes of geography. His views, though disputed at first, were eventually adopted, and in 1857 Colonel Priestley was appointed Superintendent of the Revenue Survey, with which the other surveys in progress were amalgamated. It was decided that topographical surveys should be prosecuted in non-ryotwari lands, in hill ranges and large waste tracts, while in villages paying revenue on the ryotwari system, a survey on a much larger scale was to be made.

2. Almost the entire area of the Presidency has been surveyed either by the revenue or, as they are now called, cadastral parties, or by the topographical branch, but the Atlas sheets are still based on very old surveys, and such attempts as have been made to utilise the results of more recent surveys for incorporation in the standard maps of India have not been satisfactory. Nor has the Survey of India itself attempted much work in this Presidency. Between 1860 and 1877 it surveyed a considerable part of Ganjam and Vizagapatam over areas covering 11 complete standard sheets and portions of a large number of others, but it was not till 1886 that it definitely undertook the responsibility of completing the topographical work in the Presidency. In 1884 proposals had been made for strengthening the local Survey Department, which were referred to the Surveyor-General of

India for opinion. That officer criticised the maps produced by the Madras Department very unfavourably, (a criticism which it is only fair to state was not fully accepted by the Secretary of State,) and after some correspondence and discussion it was decided, with the full consent of the Government of Madras, that the Survey of India should undertake the further topographical work required in the Presidency. A survey party was accordingly sent there in 1886-87; a comparatively small area was surveyed in the neighbourhood of Madura, and a considerable area was triangulated in the State of Travancore with a view to further surveys, when at a subsequent conference at Ootacamund in July 1888, it was decided that the survey party should be transferred to the control of the Madras Government for forest work, and that topographical work should be postponed till the Government of India could spare another party for the Presidency. This time has, however, not yet arrived. The total area which was expected in 1886 to require survey by the Imperial Department was 13,000 square miles, but out of this in addition to the small areas surveyed before the survey party was diverted to forest work, some portions have since been surveyed cadastrally, and others in the course of forest surveys. The total area which has not been surveyed at all up to date is now 6,079 square miles, but the Board of Revenue consider that owing to defects in the old surveys, a new survey will be necessary in other areas as well, and place the total area requiring new survey at 27,141 square miles in the districts of Ganjam, Vizagapatam, Tinnevely, the Nilgiris, Malabar and South Canara and in certain hill tracts in the Zamindaries of the Presidency. These figures, with some modification on account of the further extension of forest surveys, may be accepted as giving with sufficient accuracy the area that will require an entirely new survey, though it is not possible to show on the index map the exact boundaries of all the tracts concerned. In the rest of the Presidency, assistance will be obtained from the old Imperial Surveys in Ganjam and Vizagapatam, and from the cadastral or topographical surveys made by the Madras Survey elsewhere. The topographical work is in all cases of old date. The Madras parties have discontinued such work since about 1884, and the maps based on surveys made before that date will require operations little less expensive than a new survey to bring them up to the standard of modern requirements. The same is the case with the work done in Ganjam and Vizagapatam by the Survey of India. In these the hills are pure sketch work, and we are informed that inaccuracies have in some cases been found in their position. No heights are given beyond a few fixed by the Trigonometrical Survey; contouring is not attempted, and the revisional operations must be comparatively tedious and expensive.

3. To check the value for topographical purposes of the cadastral work throughout Madras would be impossible without detailed investigation in

Value of Madras revenue survey maps.

different parts of the Presidency. Test surveys were carried out in three places for the information of the Committee by the officer in charge of the party now surveying the Madras Forests with results which are creditable to the general accuracy of the Madras mapping. But, apart from some actual inaccuracies, the Madras maps reduced from cadastral maps have been found to be defective in their delineation of topographical features. In one case, for example, in which the position of some points was correct,

others were found to be wrong by about a furlong—a defect which is attributed by the Superintendent of Madras Surveys to the system of compilation of taluk maps in force between 1887 and 1894, and to the contraction and expansion of the paper on which the map tested by Captain Robertson was printed. Some hills were omitted, the drainage lines were incorrect, telegraphs, roads, railways and milestones were not shown, or were not always accurately delineated and classified, and some names were omitted. The Superintendent has examined the original village maps, and states that they do in fact contain all the details of the omission of which complaint is made. The sparseness of detail in the reduced map he explained to be owing to the fact that village boundaries, and other information of administrative importance, had to be shown, and that the additional topographical detail would have over-crowded the map. The explanation is no doubt correct. Defects similar to those found would be brought to light in Survey of India maps prepared from cadastral surveys of old dates in similar ground, *e.g.*, in the North-West Frontier Province; and in these cases, as in Madras, it is not possible to produce a satisfactory map by the simple process of supplementary survey. The elaborate traversing done in Madras will be of great assistance to the surveyor, and he may be able in many cases to use the reduced cadastral map for the delineation of the main features of the ground, but the nature of the country makes it impossible that he should proceed by the same easy methods as in the plains of Upper India. It will be advisable, therefore, to class the whole of this work as resurvey, leaving it to the Surveyor-General to determine the manner in which the Madras maps can be best utilized.

4. In the Native States of this Presidency, Travancore, Cochin and Pudukotta, a new survey will be necessary.

The Native States.

Revenue surveys are being made in all three States, but there are no topographical maps at all of recent date, those in use in Cochin and Travancore being based on surveys of 1817-20. A new survey of Travancore and Cochin was considered urgent as far back as 1887, and was agreed to by the States on condition that the expense fell on the Imperial Government.

5. The Madras Government has a large and well organised Drawing Office and an extensive reproducing establishment, where not only are the results

Locally prepared maps.

of its surveys published, but much extra-departmental work is undertaken ranging from plans and diagrams to illustrations of books. Plans of villages are now issued on the scale of 8" to the mile, taluk maps generally on the 1" scale, and district maps on the $\frac{3}{4}$ " or the $\frac{1}{2}$ " scale. For ordinary civil administrative purposes these maps appear to be found quite sufficient, though a few officers report that the want of maps showing topographical features more completely and accurately is felt; and in some cases it appears that the Indian Atlas sheets based on surveys of the first half of the last century are preferred for their topographical accuracy to the larger scale maps provided by the local Survey Department. The local maps show village boundaries, and in this Presidency there will be no imperative necessity for the Survey of India to issue maps showing such boundaries.

6. The survey of many parts of Madras will, as the recent experience of the Forest Party has shown, be expensive, and the rates given below are the lowest that can safely be applied in making a rough estimate of the cost of the survey most of which will probably be on the 2" scale:—

	Square miles.	Rate.	Cost.
		Rs.	Rs.
New survey in Malabar, South Canara, the Nilgiris, the Native States, and in scattered blocks in Ganjam, Vizagapatam, Godavari, Anantapur and Tinnevely.	27,000	40	10,80,000
Re-survey in the greater part of the Presidency...	108,200	30	32,46,000
Revision of work done by the Survey of India, chiefly recent Forest Surveys, with the 1,448 square miles done by the Madura Survey in 1886-88.	16,500	5	82,500
	151,700	...	44,08,500

MYSORE.

7. The State of Mysore is more fortunate in its maps than any other complete province of India, and affords an example of the excellent results that can be obtained when the Survey Department is allowed uninterruptedly to carry out the survey of a tract of country on a definite programme and on a single system.

The standard sheets of this State are numbered and catalogued along with those of the Madras Presidency; and its maps cover in whole or part 70 of these sheets, the survey in all cases extending to the border of the State.

The survey of Mysore commenced in 1874-75, and was completed in 1886. It included, besides the survey of the whole area—29,444 square miles—on the 1" scale, a few sheets of forest survey, and town surveys on large scales of Bangalore and Mysore. The exceptional good fortune of Mysore was no doubt due to the fact that the State itself paid for the survey, which was thus unaffected by the orders for the reduction of survey expenditure.

8. Mr. McHutchin, the Secretary to the State in the Public Works Department, has given a most favourable account of the accuracy and utility of these maps. He found it possible to lay out the railway line from Bangalore to Harihar on the map with such closeness, that little change had to be made in the alignment when he actually went over the ground to locate it, and the maps can, in his opinion, hardly be improved. Changes have been entered on the maps locally when they occurred, but it is admitted that such entries are not altogether accurate, and that it would be an advantage to have the maps revised professionally and republished from time to time. In some sheets there have been many alterations since the maps were prepared—as, for example, in the country round the Kolar Gold Fields, but many of the sheets require little change, and Mr. McHutchin considers that, as a whole, the maps could be used for another ten years without revision. It may be said, therefore, that revision, though desirable, is not urgent.

9. Before revised maps can be published it will be necessary to redraw the sheets. Most of the survey was finished before the clinometer was brought into use, and it will be desirable to increase considerably the number of heights and levels shown on the maps. But nothing more than the revision of the existing sheets in the field is necessary, and the work should neither be tedious nor expensive. Much of the country is easy to survey, and the cost of the revisional operations should not exceed Rs. 12 per square mile. The total cost may therefore be provisionally estimated at Rs. 3,53,328, for the 29,444 square miles comprising the State.

10. For civil administrative purposes taluk maps on the scale of 1" or $\frac{1}{4}$ ", and district maps on the $\frac{1}{4}$ " scale are or will be compiled from the 8" revenue surveys. There would appear, therefore, to be no necessity to show village boundaries on the topographical maps, unless the State specially desires that an edition with boundaries should be prepared.

COORG.

11. No topographical survey of this small province has been carried out by the Survey of India. Between 1872 and 1879 a topographical survey was made on the scale of 2"=1 mile, and taluk maps on that scale were published, but are now out of print. From these and from the local cadastral maps on the 8" scale the local Land Records Department has recently compiled a map of the whole province on the $\frac{1}{2}$ " scale.

12. The existing maps, while suitable for the revenue officials, do not meet the requirements of the Public Works and Forest Departments, and the absence of good maps has been felt both in connection with the working out of irrigation schemes and with the preparation of the project of the Madras-Tellicherry Railway. There can be no doubt that a new survey of this small district of 1,582 square miles is required.

13. The Surveyor-General estimates the cost at probably Rs. 30 per square mile, on the 1" scale, provided that the work is undertaken as part of a large programme for the whole of India, and the total expense would in this case be Rs. 47,460.

HYDERABAD.

14. The one-inch topographical maps of Hyderabad are made from older surveys than those of any other part of India. When the early surveys of Southern India had been completed, Colonel Mackenzie extended his operations into the Nizam's Dominions, and the maps still in use are the results of work commenced by him in 1816, and continued with interruptions to 1866.

15. For mapping purposes the total area of Hyderabad is divided into 104 standard sheets. The latest catalogue shows 24 such sheets as practically complete and 32 which are incomplete. For the rest of the territory no maps

in standard form have been published, but the whole or a considerable part of the country was mapped by *circars*, administrative areas which are now obsolete or of little importance.

The maps appear from the evidence given to have been fairly accurate, as far as they went, when originally prepared. But they did not go very far, no systematic attempt being made to do more than indicate the hills roughly; and the changes of over half a century have rendered them almost obsolete. Existing boundaries of taluks and districts are not given: many of the villages shown are no longer in existence or are not known by the names given on the map, while many new villages have since been formed and are not shown. As regards roads, the maps are entirely misleading, existing roads not being shown at all, while roads marked as main channels of communication on the map have disappeared altogether or are mere cart tracks. It is surprising that with all these defects the maps should be found to be of any use, but Mr. Perram, Superintending Engineer to the State, who was deputed to meet the members of the Committee who visited Hyderabad, finds them of considerable assistance in the consideration of his irrigation projects; though he would greatly prefer maps such as are available for Bombay and Mysore.

16. For administrative purposes taluk maps are made by joining together the village cadastral plans made by the Revenue Department, but these do not profess to show topographical detail, and will be of little use for a new survey.

17. It would neither be satisfactory nor economical to attempt to bring these very old maps up to date by merely revising them in the field, and a new survey of this State is unavoidable. The country is for the most part open with numerous hills, and the survey should be comparatively inexpensive, except in the forest tracts to the east and south.

The total area is 82,698 square miles, and judging from the cost of the work done in the Southern Mahratta country it should be possible to carry out the survey on the 2" scale at the rate of Rs. 30 per square mile. The total cost would thus be Rs. 24,80,940.

BERAR.

18. A new survey of the Berars has already been commenced by No. 2 party, consisting of young officers, Imperial and Provincial, who are undergoing a training as topographical surveyors.

19. Maps of a portion of this country on the 1" scale were published by Stanford, London, in 1880-81, prepared by lithography. They were compiled partly from surveys made by Mr. Mulheran between 1856 and 1866 and partly from the old surveys of the Hyderabad Circars. Fifty-seven of these sheets would cover the Province, but 19 of them appear never to have been prepared; and for these blanks the only Survey of India maps are those of the Circars.

Captain Riehl, who superintends the officers under training, states that he finds the maps useful, the main features being fairly accurate, but the hills and rivers are much exaggerated in the drawing, and village names

can hardly be recognised ; and, as in Hyderabad, roads and villages have changed much since the surveys were made.

20. These one-inch maps appear not to be known locally ; the Deputy Commissioner of Amraoti was unaware of their existence and they are not mentioned in the replies received from other officers consulted. For administrative purposes taluk maps compiled from village surveys are used, and there are district maps on the scale of three miles to an inch, prepared at Poona, apparently by reduction and compilation of the taluk maps.

21. A new survey is, in the case of Berar, as in that of Hyderabad, absolutely necessary. The total area is 17,710 square miles, and the cost may as in Hyderabad be taken at Rs. 30 per square mile. The survey may therefore be expected to cost Rs. 5,31,300.

CENTRAL PROVINCES.

(Excluding Berar.)

22. The Committee were unable to visit the Central Provinces, but had an opportunity of examining the officer in charge of the party now employed in revisional operations in the Saugor District ; while a very useful account of the state of the maps is to be found in the Chief Commissioner's letter to the Government of India of 2nd November 1904, and in the replies received to the questions put to local officers.

23. The maps, with the exception of those which have quite recently been prepared by the party now employed in the Province, are based on old surveys dating from 1863 to 1883. In the districts of the Nerbudda valley and those lying to the north of it, and in the centre of the Province from Betul to Raipur the surveys were made by revenue parties ; in the hilly belt from Betul to the north of Bilaspur by the Central Provinces Topographical Survey ; and in Sambalpur and other tracts in the east and south by the Ganjam and Orissa, or Vizagapatam Agency parties. Cadastral surveys by local agency, and professional forest surveys of a later date, have extended over a considerable part of the Province. To provide a basis for the cadastral surveys, a traverse survey party was sent to the Provinces in 1885, and having completed this work, it has since 1900 been employed in preparing new standard sheets from the varied material which is available. The cadastral surveys cover nearly a quarter of the Province, chiefly in the west, and the forest surveys extend over a very large and very scattered area of 19,000 square miles in all.

24. For mapping purposes the Province is divided into 271 standard sheets, but only about 130 sheets have been issued in standard form, and the majority of these are very fragmentary. For other parts of the Province there are sheets on the 1" scale not in standard form in some parts, compilations known as congregated village plans and main circuit maps in others, and maps on the $\frac{1}{2}$ " scale only in Nagpur, Wardha and Saugor, and in a considerable tract chiefly in native states in the south and east of the Province.

The existing maps, as the dates of survey show, are out of date, and they are also defective in many other respects. The maps of the Survey of India appear to be used extensively in the Central Provinces possibly because the Administration has not been able to supply locally made maps so freely as in some other provinces; possibly on account of the character of the country. The replies to the questions put by the Committee are those of persons who have experienced in their actual work, the inconvenience caused by the absence of good maps. It is complained of the topographical portions of the maps that they do not show village boundaries, and of the revenue portions that they are deficient in topographical detail. The topographical survey maps are said to be more out of date than the revenue surveys, because it is in the hilly tracts that there has been most alteration of detail. In the matter of roads, tanks, villages and village names and in the delineation of hill features, much work will be necessary to bring the maps satisfactorily up to date. From some of the opinions received, it would appear to be thought that, with the aid of information as to changes given by local authorities, and with the assistance of cadastral surveys, it will be a comparatively simple matter to bring the maps up to date, and some sheets have already been corrected and reissued in the manner suggested. The result has been most unsatisfactory. The Survey Department should not in future make itself responsible for the issue of maps as corrected up to a certain date, unless they have been thoroughly revised. The limitation of the use of cadastral maps in such a country as the Central Provinces for the purpose of revision is illustrated by some remarks of the Commissioner of Nagpur which may be quoted:—

“An endeavour was made in the time of Colonel Strahan to bring maps up to date with reference to cadastral maps. The method was very cumbrous and liable to errors and omissions.....It sufficed fairly well to show the alignment of a new road, but for no other purpose, and it was not feasible, where the existing Survey of India maps contained no village boundaries. Hundreds of village traces were sent to the Survey of India Office, and there the matter ended. I believe that the experiment of bringing maps up to date by this method has been abandoned.”

25. In the operations now going on, cadastral maps are used where possible,

Re-survey now required.

but a very large amount of fresh survey has to be done. The officer in charge of the Central Provinces party is in favour of using reductions of cadastral maps, where possible, and the cost rates of his work show that it is distinctly more economical to do so, in the country he is now employed in, than to make a fresh survey. But it is not possible to produce good topographical maps of such a country as the Central Provinces by such supplementary survey as is sufficient in Bengal, though the utilization of reductions showing trijunction points, boundaries, roads and main streams will greatly facilitate the work of the surveyor, and enable him to proceed at a much more rapid pace than would be possible in a new survey. Work of the class now being done may, therefore, be classed as re-survey throughout, while in the districts and tracts where there are only $\frac{1}{2}$ " maps at present a new survey will be required. The total area of the Province, including native states, is 115,894 square miles. The party now at work has recently revised the maps of some 12,000 square miles in Jubbulpore, Saugor, Damoh, and Narsinghpur. The cost rate of the work now to be done, which will generally be on the 2" scale, after making allowance for the assistance that will be obtained

from forest and cadastral surveys over large areas, may be put provisionally at Rs. 18 per square mile for resurvey and Rs. 30 for new survey. The production of topographical maps for the Province will therefore cost about 21½ lakhs.

26. The Central Provinces have no local arrangements for the production of maps. Maps on the $\frac{1}{2}$ " scale appear to have been occasionally prepared by the Survey of India for the Administration in places where there have been revenue surveys, and traces on the 1" scale of tahsils have been made for the use of subordinate officials. These latter contain no topographical detail, and merely show the collection of villages included in the area dealt with. While some such plans are no doubt required by local officers, their use has not been without disadvantage, and the Commissioner of Nagpur remarks:—

"In many cases, however, great errors in appropriate subdivision have occurred from trusting these *mujmilli* maps. The same want of maps combining village boundaries with topographical detail has caused many inappropriate boundaries between tahsils and districts."

BOMBAY.

27. The Presidency of Bombay (with which for survey purposes the State of Baroda may be included) is better equipped with standard topographical maps than any part of India excepting Mysore. To the north in Cutch, Guzerat and Baroda the maps are indeed based as a rule on very old surveys, dating in some cases as far back as 1869; but even in these parts some of the sheets are the results of surveys made after 1880 and the whole of them are excellently drawn and well reproduced. Further south the comparatively modern maps prepared by the Southern Mahratta Survey party which was at work up to 1896 become available. Some of the sheets in Cutch are published only on the $\frac{1}{2}$ " scale and here a new survey will be required. In the extreme south there is a small area extending over one standard sheet and portions of four others, for which no maps exist.

28. While it has not had the advantage of a systematic and continuous survey throughout its entire area, Bombay may be considered to have been exceptionally fortunate, as compared with other provinces, in the arrangements made for it by the Survey Department. The surveying done by the Southern Mahratta party, as well as some of the work of other parties, was on the 2" scale, and a number of sheets have been published on that scale as well as on the 1". Of the usefulness of these maps, especially those of more recent date, there is information from all classes of officers. A special feature of Bombay is the extent to which the maps have been used by Irrigation Officers, from whom—and especially from Mr. Beale, the Superintending Engineer on special duty,—opinions have been received to which the detailed examination, which they have made of the maps in the course of their duties, lends special value. Even the maps of Cutch are favourably reported on by the Political Agent though, being old, they stand in need of revision. Officers of the Railway Branch have given similarly favourable opinions; and the criticisms of the Bombay maps generally assume the form of suggestions for their further improvement. In some cases inaccuracies have been pointed out which are owing, as a rule, to changes in roads or village sites since the

maps were made. The majority of the maps have not been contoured, even roughly, at any definite vertical interval, as they were executed before any instrument suitable for the purpose was introduced; and the most urgent demand made is for more levels. The great insistence with which the request for additional levels has been pressed by almost all the engineers, whose opinions have been received, may be taken as showing the direction in which even the best and most modern topographical maps of India require most revision.

29. There seems to be no doubt that, in practically the whole of this Presidency, the maps may be accepted as thoroughly satisfactory provided that they are brought up to date by revision.

Revision required.

The total area of the Presidency with Baroda but excluding Sind is 143,800 square miles, of which 141,100 square miles may be classed as requiring revision and 2,700 square miles as requiring original survey. The cost may be taken as Rs. 12 per square mile throughout, involving a total expenditure of 17½ lakhs.

30. Owing to the possession up to four years ago of a Revenue Survey of its own, and to the existence at Poona of a well organised reproducing office, the Presidency of Bombay is unusually well supplied with maps other than those issued by the Survey of India. The village maps of the revenue survey, prepared on the scale of 8" or 16" to the mile, have been used in the compilation of taluka maps on the 3" scale, and these again have been incorporated in district maps. In other cases district maps have been prepared on the 1½" scale by reduction from the topographical maps of the Survey of India, with corrections made from information supplied by local officers to keep them up to date. It is not claimed for the locally prepared maps that they are topographically complete or accurate; but these maps, some of which are issued with vernacular as well as English names, are useful for administrative purposes.

Locally prepared maps.

31. Of small scale maps, the only one which has been prepared for Bombay, apart from the Indian Atlas sheets, is the 1½" map of the whole Presidency, though an outline map on the 1¼" scale is in course of preparation. Large maps of a number of towns and cantonments have been prepared on various scales ranging from 6" to 80" a mile. The survey of the town of Bombay itself is not amongst those that have been undertaken by the Survey of India.

Small scale maps.

SIND.

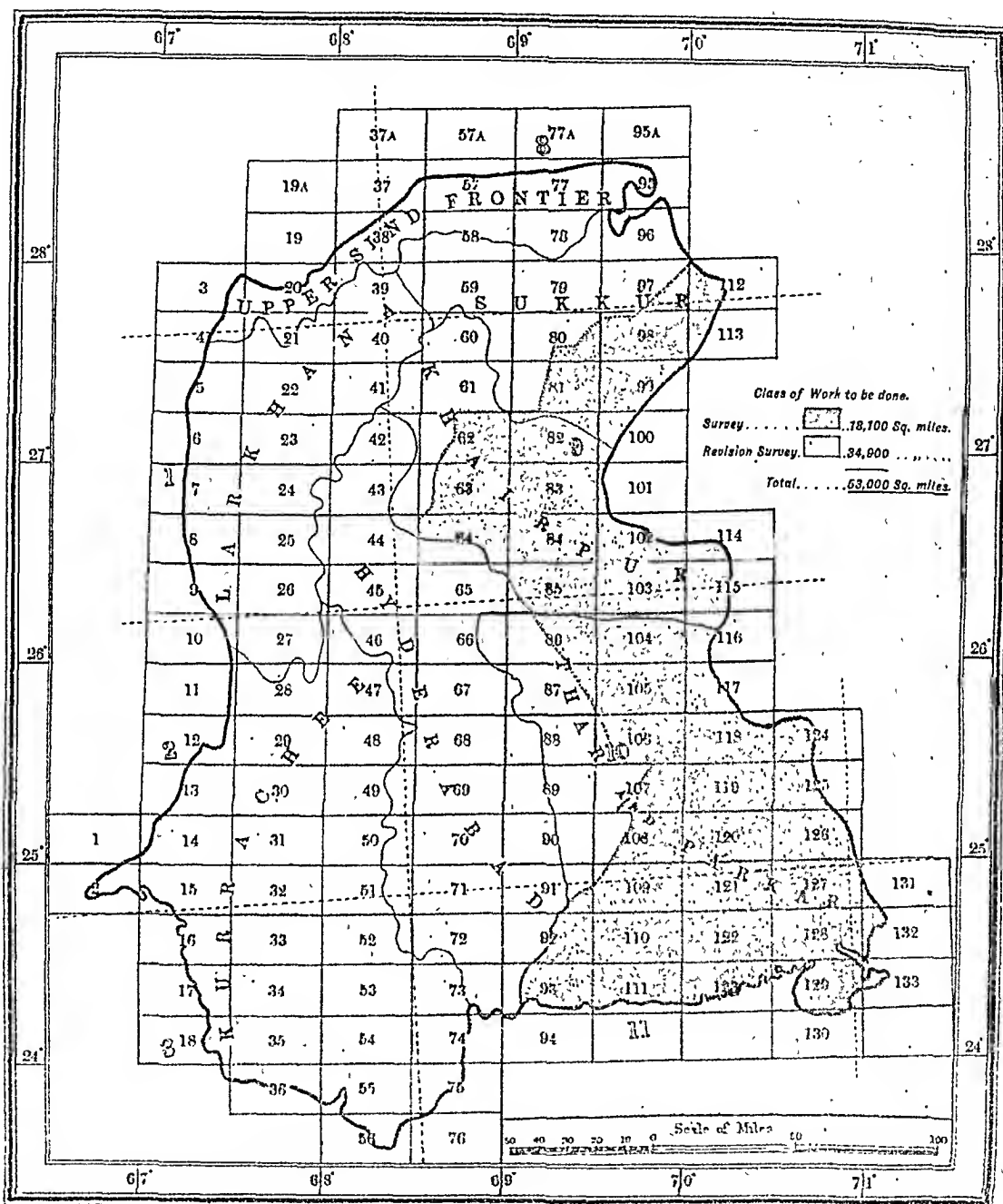
32. The whole of Sind was originally surveyed between 1855 and 1870 by a Revenue Survey party on the 4", 2" or 1" scale. These surveys were published on the 1" scale on sheets measuring 30' Long. × 20' Lat. The maps are now quite out of date.

Previous survey.

33. In 1895 No. 12 Party and a detachment of No. 15 commenced a new topographical survey. Previous to this, from 1892 to 1895, a special detachment had surveyed the Indus on the 1" scale. The state of the mapping of

Topographical survey now in progress.

INDEX TO THE STANDARD SHEETS OF SIND



NOTES

Sheet 810, Calcutta

No. 30 B 1—Feb. 25—200

No. 273, B 1—Oct—June 03—200

No. 267 L, R & A—Nov. 03—200

The numerals 1, 2, 3, & 4 denote the new series of consecutive numbers assigned to the Sheets of Standard size, viz 15° Latitude by 30° Longitude on the Scale of 1 Inch = 1 Mile.

The figures 100 and 1000 in large represent the numbers and limit of the Enclosed Sheets of the Indian Atlas on the Scale of 1 Inch = 4 Miles.

Reg. No. 653-S. 05.

the Province now is as follows, taking it by districts, and allowing for work which will be done by the end of this field season (1904-05):—

Karachi all surveyed lately on the 2" or 1" scale	11,971 sq. miles.
Larkana all surveyed lately on the 2" or 1" scale	5,051 " "
Upper Sind Frontier all surveyed lately on the 2" scale	2,631 " "
Sukkur—{ part recently surveyed on the 2" scale (about)	3,300 " "
{ and remainder surveyed on the ½" scale (about)	2,099 " "
Khairpur State { a small part recently surveyed on the 2" scale (about)	1,200 " "
{ remainder surveyed on the ½" scale (about)	4,850 " "
Hyderabad—whole recently surveyed on the 2" scale	8,248 " "
Thar and { a small part surveyed on the 2" scale (about)	2,500 " "
Parkar. { remainder triangulated for ½" survey which will be completed next year (1905-06)	11,198 " "

None of the ½" work (all desert) has been published.

Some 75 standard sheets have been published on the 1" scale, and of these some 23 have also been published on the 2" scale at the request of the Irrigation Department.

34. Out of the total 53,043 square miles comprised in Sind, there is therefore material for mapping about 34,901 square miles on the 1" scale, revision only being required. The remaining 18,142 square miles will have been surveyed both by the revenue survey, and on the ½" scale, so that a new survey will be required if 1" maps are to be produced, but as the country is all desert there is no urgency in the matter.

The approximate cost rates per square mile will be—

	Rs.
Survey (chiefly desert)	15
Revision (if undertaken at once)	2

35. The Canal Engineers are unanimous as to the extreme use to them of good topographical maps with plenty of levels—2" scale, if possible. The District Officers generally find the extremely rough maps or plans prepared by the Superintendent, Land Records and Agriculture, Sind, more useful than the Survey of India standard sheets, owing to the absence of revenue detail on the latter.

Collectorate maps on the ½" scale for reduction to the ¼" scale are being prepared by No. 12 Party.

36. The ¼" Atlas sheets of Sind are quite out of date, and the results of the recent surveys have not been incorporated in them.

Atlas sheets.

BALUCHISTAN.

37. The area of this Province may be taken at 132,300 square miles. The following maps exist:—

Existing maps.

- (a) 1 inch=16 miles, of the whole Province, published in 1901.
- (b) 1 inch=8 miles, of the whole Province, compiled from ¼" maps and published in various years from 1897 to 1903.

(c) 1 inch = 4 miles, of the whole Province, published in various years from 1893 to 1903. The area west of 66° longitude (65,600 square miles) was reconnoitred on that scale. East of 66° longitude the maps were compiled by reduction of the $\frac{1}{2}^{\circ}$.

(d) 1 inch = 2 miles. The part of the Province to the east of 66° longitude (66,700 square miles) has been surveyed on this scale.

All the above maps are generally accurate as regards physical features, but some of them require more heights, classification of roads, and additions from the recent surveys on the $2'' = 1$ mile scale. They also require corrections regarding names of localities and villages. Political boundaries and approximate tribal limits also requires examining.

A small portion of the country round Quetta was surveyed between 1884 and 1887. No. 15 Party commenced to extend this survey in 1903, and also to revise the sheets of the 1884-87 survey. By the end of this season (1905) 2,740 square miles on this scale will have been surveyed, and this is the only material available for the publication of $2''$ or $1''$ maps. This leaves 129,560 square miles to be surveyed. The cost may be taken at Rs. 75 per square mile, giving a total approximate estimate Rs. 97,20,000. The cost of survey is much increased by the necessity for escorts, and we think it would be reasonable not to charge such expenses against the Survey estimates.

38. The military authorities have asked for maps to be published on the $2''$ scale of the area north of the general line Dera Ismail Khan-Loralai-Kalat, along latitude 29° , taking in Chagai. This may be taken as 34,000 square miles. Having regard to the nature and importance of the remaining 98,300 square miles, it would seem sufficient if they were surveyed on the scale of publication, viz. :— $1'' = 1$ mile.

The approximate cost would then be—

$2''$ survey.—34,000 minus 2,740 = 31,260 square miles @ Rs. 75 = say, Rs. 23,45,000.

$1''$ survey.—98,300 square miles @ Rs. 40 = say, Rs. 39,30,000—a total of Rs. 62,75,000.

Three parties would take about $6\frac{1}{2}$ years to complete the 31,260 square miles considered urgent by the military authorities.

CENTRAL INDIA AND RAJPUTANA.

(Including Ajmer-Merwara.)

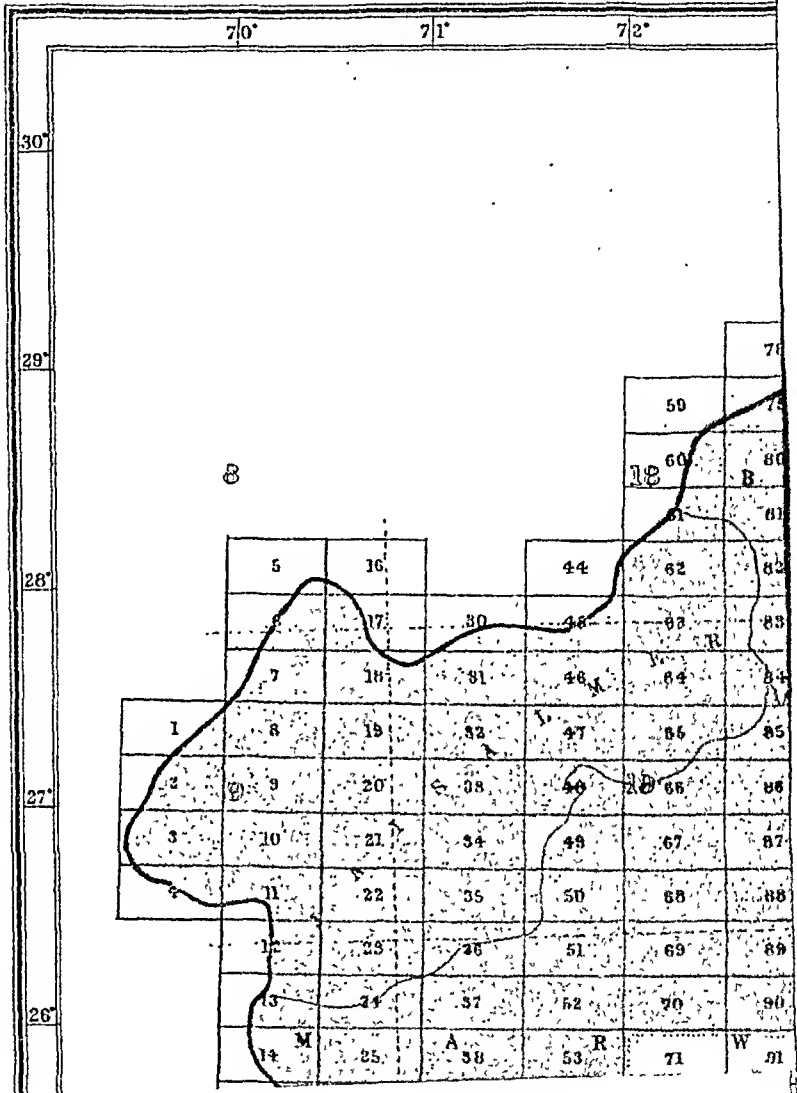
39. The Committee were unable to visit this part of India, but deputed Central India not visited by the Committee. Colonel Kelly to consult the local officials. In this large area no question can arise either as to the advisability of bringing the maps up to date or as to the measures required for the purpose.

40. Apart from the standard sheet mapping, there are of Central India and Rajputana the following maps :—

Existing maps.

(a) a general map on the $\frac{1}{16}''$ scale of the Central India Agency;

INDEX TO THE STANDARD



In the Cis-Sutlej territories maps had been made between 1832 and 1849, some of which still form the basis of the present maps of these districts. But immediately after annexation, the attention of the Board of Administration was directed to the two points which still, after the lapse of more than half a century, are the main objectives of the maps of the Province, *viz.*, military requirements and the development of the tracts in the plains. Within the first year of British rule, scientific surveys were conducted for the Grand Trunk Road to Peshawar, and for the Bari Deab Canals. Among the main reasons for having good maps in the Punjab are still the prime importance of the North-West Frontier from a military point of view; and the assistance such maps give to the extension of canal irrigation.

45. The first British rulers of the Punjab not only came from the North-West Provinces, thoroughly trained in an advanced system of revenue administration, but inherited from the Sikhs an efficient and, for the time and circumstances, extraordinarily good revenue system. The necessity of preparing reliable maps of the country for revenue purposes was therefore at once forced upon them. Survey parties belonging to the Revenue Branch of the Survey of India were promptly detailed to carry out this work, and with such energy was it pushed on that between the years 1849 and 1863 complete village maps on the 4" scale were prepared for the whole of the plains country east of the Indus. The features of the hilly, and in parts mountainous, districts of Jhelum and Rawalpindi rendered this part of the Province unsuitable ground for revenue surveys; they were accordingly topographically surveyed on the 1" scale during the years 1851-59. The survey of the frontier districts was then undertaken; between 1863 and 1870 Peshawar and Hazara (hilly portion on the 2" scale); in 1870-74 Dera Ghazi Khan, and in 1873-82 the trans-Indus portions of Bannu and Dera Ismail Khan were surveyed on the 4" scale up to the foot of the border hills. The survey of the Kohat District, like Rawalpindi and Jhelum, was not attempted by the Revenue Survey parties owing to its comparatively small cultivated area and the hilly nature of the country; it was finally surveyed topographically in 1881-83 on the 1" scale.

Excluding, for the moment, the Himalayan districts of Kangra and Simla and the hill portions of Gurdaspur, Hoshiarpur and Umballa, the above account explains the early surveys of the districts of the Punjab, as they stood till quite recently. The newly formed districts of Mianwali, Attock and Lyallpur are included in the districts from which they have been carved. There remain the Sikh States in the east of the Province and the Mahomedan State of Bahawalpur on the south. The survey of the Sikh States was a 2" *pargana* survey conducted during the years 1847-49, while in Bahawalpur a 4" survey of the riverain tracts and a 2" survey of the desert portion were carried out in 1869-74, the result being published in 48 sheets on the 1" scale in 1876. The production of a map for the whole of the Punjab, excluding the Himalayas, was therefore completed with the end of the Kohat survey in 1883-84.

It will have been noticed that practically over the whole of the Province the surveys were undertaken in the interests of the revenue administration. The nature of the country where, with the exception of the large rivers and

the recent artificial extension of railways and canals, there are few topographical details of much importance, lent itself to this treatment. If proper steps had been taken to ensure the keeping of the Revenue Survey maps up to date, and the insertion by supplementary survey of the slight amount of topographical detail required, the Punjab should now possess perfectly serviceable maps for most of the districts in the plains.

16. The Survey Resolution of September 1882 has been referred to on several occasions. The completion of the 4" revenue survey of Dera Ismail Khan and Muzaffargarh, and the Murree and Kahuta hill forests in Rawalpindi, set free a party for the topographical survey of the Hissar district where the first attempt was made to carry out one of the main objects of the Resolution, *viz.*, the establishment of a direct connection between the work of the Survey of India and the cadastral work of the village patwaris. The Hissar Survey was a topographical one on the 2" scale, but it included the determination by traverses of points, (to be permanently marked,) in the interior of the village lands, at intervals of about half a mile, as well as the ordinary traversing of the village boundaries usually carried out in 4" *mauzadar* surveys. These points were to furnish a basis for the cadastral survey, and the plan was expected to greatly facilitate the mapping of changes and the keeping of the maps up to date generally. The district (as it was then bounded) was completed in two field seasons during which time 3,443 square miles were surveyed at an average cost of about Rs. 33 per square mile. The traversing was estimated to have cost about Rs. 20 per square mile. The maps were published in 1885 on the 2" and 1" scales in standard form.

The cost of this elaborate traverse was, however, felt to be excessive, and it was decided to restrict the scientific work to the lowest necessary limit. The professional survey work was therefore confined to—

- (1) the skeleton traversing of villages for the purpose of determining the co-ordinate distances of trijunction points; and the projection of maps of trijunctions on the scale of two inches to the mile;
- (2) the insertion of topographical details on these maps by reduction from the settlement survey village maps;
- (3) the testing and correcting (where necessary) the reduced map by examination in the field;
- (4) the drawing of fair maps on the two-inch scale.

It was found that the reductions from the settlement survey maps, when tested, were very correct representations of the ordinary topographical features, and only a few omissions had to be supplied by new surveys. The errors of survey were not greater than were found to become eliminated in the process of reduction. The omissions which had to be inserted at the time of the test were the high banks of rivers, bridges, temples, milestones and the correct limits of village sites.

Work on this system was carried on in the plains districts for six years from 1884-85 to 1889-90. During this period 30,145 square miles were traversed (*i.e.*, trijunction points were fixed,) at an average cost of Rs. 7 per square mile, and 13,822 square miles were tested and finally mapped on the

2" scale, at an average cost of Rs. 7-2-0 per square mile. The traverse and test survey covered the districts of Ferozepore, Jullundur, Ludhiana, the plains portions of Umballa and Hoshiarpur, part of Jhang and the Native States of Kapurthala and Faridkot; while the traverse was extended over the districts of Lahore, Amritsar, Gurdaspur, Sialkot, Gujranwala, Gujrat, Shahpur and the remainder of Jhang. In the Phulkian States of Patiala, Jhind and Nabha a 1" canal survey was executed, but the party employed in the Punjab was disbanded in 1889-90 in pursuance of the orders for the reduction of survey parties. With the exception of an area covering about five standard sheets in the Jhang District, the whole of the traverse work done between the Sutloj and the Jhelum has been lying unutilized up to the present time. The rapidly developing central districts of the Punjab have had to put up with maps fifty years old, when a very little extra work and expenditure would have given them new maps later than 1890. The result of the traverse party's labours was the publication of revised maps in standard sheet form of the districts of Ferozepore, Hissar, Umballa (part), Ludhiana, Jullundur and Hoshiarpur (part), and the states of Kapurthala, Faridkot, Patiala, Jhind and Nabha. This area was mapped in 51 complete sheets, and portions of 18 others, out of the 340 sheets which cover the Punjab and North-West Frontier Province.

47. Supplementary work of this nature was not resumed until 1901-02,

Recent supplementary survey.

when the topographical party which had been surveying in the Kangra and Simla

Hills since 1884-85 (its work there will be noticed immediately) was moved down to the plains. During the last three years supplementary survey has been completed in the Lahore District, and in portions of Amritsar, Montgomery, Ferozepore, Multan and Muzaffargarh. This area measures roughly 12,600 square miles. Standard sheets on the 2" scale have also been published of a small tract along the Chenab River in the Multan District. These areas have been omitted from the calculations for the future survey programme.

48. A very large amount of cadastral material has been prepared by the

Cadastral material available for supplementary survey.

Punjab Settlement Department within the last fifteen years, which might have been utilized in the compilation of new

topographical maps, had the system inaugurated in 1884 been persevered in. The districts of Lahore, Amritsar, Gurdaspur, Gujranwala, Sialkot, Gujrat, Shahpur, Dera Ghazi Khan, Muzaffargarh, Montgomery, Multan and Jhelum have been mapped since about 1890. The Government of India in their Agricultural Resolutions of 1896 noticed favourably the Punjab system of keeping land records and cadastral maps up to date. The mapping of the fields is carried out by the local patwaris, or village accountants, to whose training in survey work the Local Government attaches great importance. From the experience of the Survey officers who have done supplementary work on the Settlement maps, the results appear to be sufficiently accurate to be of considerable assistance in preparing revised maps, provided the mapping of the local agency is confined to villages in the plains, and is connected with the professionally ascertained triangulated points. But a rigid supplementary survey is required in all this tract, to ensure the proper classification of roads, streams and nullahs, and to secure the entry of such topographical detail as the patwari omits as being unnecessary for revenue purposes.

For the whole of Sialkot, Gujranwala, Gujrat and Shahpur, the plains portion of Gurdaspur and the remaining part of Amritsar, complete traverse data are available. A supplementary survey should be carried out in these districts as soon as possible, before the cadastral maps—now already 10 years old—become any further out of date; the area is about 14,460 square miles and the cost of reducing the patwari's maps and carrying out the supplementary survey should not be more than Rs. 10 per square mile when the parties are in full working order.

In the remaining portions of Montgomery, Multan and Muzaffargarh in Dera Ghazi Khan, which have recently been settled, and in the new Mianwali District, at present under Settlement survey, where traversing will be required—the cost will be somewhat greater. It will suffice to take a rate of about Rs. 15 per square mile for 18,800 square miles.

In the Cis-Sutloj part of the Punjab plains there are four districts, Delhi, Karnal, Rohtak and Gurgaon, with an area of 8,224 square miles, where the only maps are 1" district sheets, compiled previous to 1850 from the 4" revenue village surveys. Gurgaon and Karnal are at present under cadastral survey, and it is understood that Rohtak and Delhi will come under re-survey by the settlement staff within the next two years. In these districts supplementary survey will suffice, but it is advisable that a preliminary traverse should be made to form a check on the cadastral operations. Under this category may be placed the Native State of Bahawalpur with its 15,000 square miles of territory. In the parts of this State in which a re-survey is required the cost will probably not exceed that of supplementary work.

49. In the three northern districts of Jhelum, Rawalpindi and Attock the maps are 45 to 50 years old. This is the most important part of the Province from the military point of view, but, although Rawalpindi is the constant scene of military manœuvres, no reliable military maps exist, with the help of which an officer could lead troops accompanied by guns and baggage with certainty from any one point to any other point across country. This grave defect should be remedied as soon as possible. The broken nature of the country makes it unsuitable for the compilation of maps from cadastral material. The contouring and delineation of the hill features must be accurate and all topographical details must be mapped. A new topographical survey of these three districts, covering an area of 8,845 square miles, is therefore necessary. The cost of re-survey on the 2" scale will probably be Rs. 45 per square mile.

The new district of Lyallpur covers that portion of Jhang which was traversed, but not tested and mapped, in 1889-90. But the creation of the Chenab Canal Colony and of the similar colony on the Jhelum Canal in the Shahpur District, has rendered the previous traverse data quite out of date and insufficient. From the evidence received, there is reason to believe that the squares, which were laid down by the Irrigation Department for colonization purposes, were extended over too large an area from a single base, and have in places become distorted. The whole face of the country has been entirely changed since any of the existing maps were made, and in the two Colonies it will be better to make a complete re-survey at once, using the available material as far as possible rather than attempt supplementary work. The re-survey will include a traverse of the trijunction points of the newly

formed villages, so as to assist future cadastral surveys, but will not cost nearly so much as the work in Jhelum. A rough estimate at the Jhelum rate for 4,000 square miles will cover the expenditure.

50. The districts of Umballa, Hissar, Ferozepore, Ludhiana, Jullundur,

Revision required.

Hoshiarpur (plains portion), part of Jhang, the Sikh States of Patiala, Jhind,

Nabha and Faridkot and the State of Kapurthala and other minor states, such as Maler Kotla, have 1" maps which were prepared after the supplementary surveys of 1884-89. These maps are of comparatively recent date, and are reported to be sufficiently accurate as to details. In this area of roughly 24,600 square miles it will be quite sufficient to revise the maps.

51. There remains the tract in the Himalayas covered by the districts of

Survey work in the Himalayas.

Kangra, Simla and the Simla Hill States, Lahoul and Spiti, and the montane por-

tions of Umballa, Hoshiarpur and Gurdaspur. The triangulation of this area was commenced by the Himalaya, subsequently No. 18 Party, in 1884-85. Up to 1900-01, when the original programme of the party was completed, the hilly portion of Hoshiarpur, Simla and the Simla Hill States, along with Mandi and Sukot and a portion of Kangra had been surveyed on the 2" scale, while the hills of Umballa and Gurdaspur, the State of Sirmur, and the remainder of Kangra and Kulu had been surveyed on the 4" scale; on the northern and eastern edges of this wild and inaccessible country a 1" survey was carried out for small tracts here and there. The decision to survey these mountainous tracts on such large scales was arrived at in connection with the possible requirements of the Forest Department, but it involved an expenditure quite out of proportion to the value of the country being surveyed and a great waste of time. The work of issuing fair maps was also allowed to fall into arrears, and the officer now in charge of the party can give no clear idea of when these arrears will be overtaken. Up to date only 3 full standard sheets and portions of 5 others have been published on the 1" scale, 5 full sheets and portions of 10 others have been mapped on the 2" scale and 3 full sheets and portions of 18 others have been prepared on the 4" scale. Practically all this 4" work is included in the maps issued on the 2" scale, but the publication of the results of these 17 years' survey work in the Himalayas is still very patchy and incomplete. Most of the work is quite recent, and there can have been practically no changes in the features of the country. Special arrangements should now be made to secure the publication of maps on the 1" scale of all the country which has been surveyed, and in the estimates an allowance of Rs. 5 per square mile has been made to cover the work on the 19,000 square miles referred to. There still remains an area roughly estimated at 6,000 square miles towards Tibet of which no regular survey has ever been made, though $\frac{1}{4}$ " reconnaissances exist. There is no urgent need for maps of this country which can be taken up at the end of the Punjab programme. The cost of survey on the 1" scale will probably be about Rs. 40 per square mile.

Summary of requirements.

52. The requirements of the Punjab are summarised below:—

Survey	6,000 square miles on the 1" scale at Rs. 40.
Re-survey	12,900 square miles on the 2" scale at Rs. 45.
Revision	24,600 square miles on original scales at Rs. 10.

Supplementary survey.	{ 41,140 square miles } { 14,460 square miles }	on the 2" scale at { Rs. 15. Rs. 10.
Mapping of	19,000 square miles in the hills	on the 1" scale at Rs. 5.
No work required at present in	12,000 square miles	recently brought up to date.
Total	... 133,700 square miles.	

The total expenditure should not exceed twenty lakhs.

53. The Punjab Government has a complete system for the local preparation of maps for revenue purposes. The

Special and locally prepared maps. detailed field maps on the 16" or 24" (or

even larger) scales are reduced by scale to 4" village maps, known as index maps. Where fresh cadastral surveys have been conducted, those maps take the place of the old 4" maps of the Revenue Survey. The index maps are grouped together on the same scale on convenient sized sheets to form tahsil maps, and from these reductions are made by pentagraph to the 2" or 1" scale for the use of district officers and their subordinates. The larger scale maps are prepared in the vernacular, the smaller in English. When necessary, a further reduced map on the $\frac{1}{2}$ " scale is prepared for a whole district.

The majority of these maps are mere skeletons or indices, and do not profess to show any topographical detail beyond the administrative details required by district officers. They, however, answer all the immediate requirements of revenue administration, and are in constant use in preference to the obsolete maps of the Survey of India. From the replies to the Committee's questions it is evident that throughout the Province there is a desire to have maps showing full topographical details, and it is only because of the absence of such maps that so much reliance is placed on the locally prepared reductions of the field maps. These maps are not published, nor is there any establishment in the Punjab for their reproduction on a large scale. A few copies only are printed by rough lithography at a Native Press in Lahore.

54. There is a consensus of opinion that the most useful map for the district officer is one on the $\frac{1}{2}$ " scale, showing as much topographical detail as possible.

District maps.

Owing to the inconvenience caused by the absence of up to date maps for almost every district in the Province, the Punjab Government in 1895 made arrangements which are detailed in the joint reply received from the Financial Commissioner, the Settlement Commissioner and the Director of Land Records, to select one map for each district which should be revised every ten years, or in the case of railway or canal extensions every five years. The map selected is generally on the $\frac{1}{2}$ " scale.

NORTH-WEST FRONTIER PROVINCE.

55. The country designated by the name of the North-West Frontier

Province divides itself into two portions,
Composition of Province. viz. :—(a) the area inside the admin-

istrative border, and included in the five districts of Hazara, Peshawar, Kohat, Bannu and Dera Ismail Khan with the outlying Agencies on the Malakand and in the Kurram, Tochi and Gumal valleys; and (b) the tract outside the administrative border, but inside the Durand line and within the sphere of British influence.

56. The methods and dates of the original surveys of the five districts of the Province have been already described in paragraph 45 relating to the Punjab.

Previous surveys.

The existing maps of Peshawar, Bannu and Dera Ismail Khan are compilations from 4" village surveys, and that of Hazara from 2" village surveys, all executed between 1863 and 1882 by Revenue Survey Parties. The sheets of the Kohat map are the result of a topographical survey conducted in 1881-83.

57. Since these dates the whole of these five districts have been re-surveyed cadastrally. The measurements of

Cadastral mapping.

Peshawar were completed by the Settlement staff in 1896, of Dera Ismail Khan in 1903, and of Kohat in 1904, while Hazara and Bannu will be finished in the course of a year or so. But in country of the nature of the North-West Frontier, much assistance cannot be expected from cadastral maps. There are stretches of flat level country, especially towards the Indus in Peshawar, Bannu and Dera Ismail Khan, but along the border the face of the land is covered with mountains and hills, and broken by ravines and hill torrents. From the military point of view, it is more important to have good maps of the North-West Frontier than of any other part of India, and the features which the cadastral surveyor omits are precisely those which are of importance to the soldier.

58. Of the incompleteness and untrustworthiness of the existing maps ample evidence has been received.

State of the maps.

The Chief Commissioner in his letter dealing with the Departmental Committee's Report gives several instances of inaccuracies in some standard sheets of the Peshawar District, issued within the last four years, which the Committee had an opportunity of examining at Peshawar. They appeared to have been compiled by the incorporation on the old 1" maps of the new detail given in reductions of the cadastral maps, but apparently no supplementary survey of topographical details, or test in the field was carried out. The consequence is that the roads are not properly classified, important canals are not correctly shown, and the names of villages are printed without due regard to their relative importance. Owing perhaps to the fact that the original maps are based on revenue surveys now 40 years old and carried out at a time when there was considerable danger involved in survey work on the border hills, the delineation of the hill features and of the ravines and streams is very vague and difficult to follow. The evidence received shows that even the recent issue of the 1" standard sheets of Peshawar gives a map which is positively misleading both to the civil and the military officer. The condition of the maps of the Bannu and Dera Ismail Khan Districts is said to be worse. In Bannu the map does not show one of the most important features of the district, the canal system which irrigates over 150,000 acres. This has necessitated quite recently the local preparation of a new map of the canal area by an engineer of the Public Works Department. In Dera Ismail Khan the changes in the course of the river Indus and the destructive action of the hill torrents are continually causing changes in the face of the country, so that the old maps are now hopelessly out of date. In Kohat, with the exception of the construction of the railway and a few roads, and the advance of the boundary of the district to the top of the Samana Range, there have not been many changes since the excellent

topographical survey twenty years ago. Nor have the changes in Hazara been very numerous, but in this mountainous tract a map compiled from a 2" revenue survey, now 35 years old, hardly satisfies modern requirements.

59. These remarks indicate the action which should now be taken. All five districts should now be re-surveyed topographically on the 2" scale, if only because a thorough topographical survey has never been executed in this important tract, and the Commauder-in-Chief requires 2" maps. In Kohat, where the existing map is the result of a topographical survey, a revision would have sufficed, but as maps on the 2" scale are required for military purposes it will be necessary to have a resurvey. In this district a professional traverse was carried out in 1899-1900 for the settlement maps which will greatly facilitate the work. Some assistance will also be afforded in all the districts by the settlement maps.

The area thus indicated for resurvey is:—

					Square miles.
Hazara ...	...	...	...	...	3,391
Peshawar	...	...	...	...	2,605
Kohat	...	...	...	...	2,609
Bannu ...	...	...	...	...	1,680
Dera Ismail Khan	...	...	...	...	3,403
Total					13,688

This work will occupy a full strength topographical party for about four years and will cost about Rs. 45 per square mile. The total expenditure may be estimated at a little over six lakhs.

60. The maps in use in the Agencies and for the country across the administrative border are the $\frac{1}{2}$ " standard sheets of the North-West Trans-Frontier Series. These have been compiled from various reconnaissances surveys made at different dates, as the opportunity of sending surveyors with expeditions offered itself. They are published in modern style with the hills in brown, and afford what information is available of this part of the country. During the past field season a topographical party has been at work surveying the Tochi and Gomal valleys on the 2" scale. It is estimated that along with this area the tract round Wana and the strip of country between Thal and the Tochi, covering in all 1,410 square miles, will be finished in 1905-06. This work should not be interrupted on any account. A similar survey should be carried out in the Kurram Valley, and in the tribal area outside the administrative border as opportunity offers. The area to be thus dealt with is estimated at 25,000 square miles, but no cost rates of any value can from the nature of the case be assumed.

61. There is little to say under this head which would not merely repeat the remarks already made in the section on the Punjab. For general use the district officers have been making use of the $\frac{1}{4}$ " district maps furnished by the Survey of India, but in Peshawar this map is so incorrect that the civil officers at least have had recourse to a collection of small scale maps made by the settlement officer and incorporated in the District Gazetteer.

The settlement officers prepare, under the rules in force in the Punjab, reductions from their field maps on the 4", 1" and $\frac{1}{2}$ " scales. These show village boundaries and all the chief administrative details, and are more useful than out of date Survey maps. However, all the officers serving on the Frontier, who have been consulted, agree unanimously in stating that maps containing full topographical details are absolutely essential to them in their everyday work.

KASHMIR.

62. The survey of Kashmir and the mighty mass of mountains up to the

Early surveys.

Tibetan frontier was commenced by the trigonometrical branch of the Survey in

1855. Along with the triangulation the topographical filling in of the map by plane table was carried out chiefly on the $\frac{1}{2}$ " scale. The Kashmir series of triangles was completed in 1864, by which time 70,000 square miles of country, covering Jammu, Kashmir, Kaghán, Ladák and little Tibet, had been surveyed. In the valley of Kashmir the map is full and detailed, but in the wilder mountain regions it is in many places compiled from rough sketches. In the annual reports of the Survey of India the whole of the map of Kashmir is shown as based upon geographical reconnaissances on various scales. As these reconnaissances are more than forty years old the map is now out of date.

63. Since these early days little or no survey work has been carried out in

Recent surveys.

the east of Kashmir, but to the north-west the placing of outposts in Gilgit

and Chitral has led to the mapping of the country between Chilas and the Pamirs and westwards to the borders of Kafiristan. Since 1898-99 survey detachments have been steadily employed on this work in the hot weather. All this recent work has been on the $\frac{1}{2}$ " scale, and so far most of the maps published have been on the $\frac{1}{4}$ " or $\frac{1}{8}$ " scale.

64. There is at present no 1-inch map of Kashmir, nor has any survey

Survey requirements.

ever been executed on that scale. There is, therefore, no question of the class

of survey work now required. Part of the tribal area beyond Kashmir is of importance from a military point of view, though the military authorities do not place it so high in the matter of urgency as the rest of the North-West Frontier Province. In Kashmir itself there has been great development and new maps are required. New villages have sprung up in large numbers and the making of roads has been actively pushed on. There is at present no map in existence showing correctly the boundaries of administrative divisions. The Conservator of State Forests has brought to notice the want of a topographical map on the one inch scale to enable him to work the forests, while the Chief Engineer of the railway survey, now being carried out, reports that an immense amount of work has been caused by the absence of accurately contoured maps.

An up to date 1-inch map should now be provided, and to produce it a new survey must be undertaken. In view of the rugged nature of a great part of the country it will not be necessary to survey on a larger scale than the 1-inch, except perhaps in the main valley. The cost of the survey will be about Rs. 30 per square mile, giving a total expenditure of Rs. 24,27,000 in the 80,900 square miles at which the area is estimated.

UNITED PROVINCES OF AGRA AND OUDH.

65. A very complete account of the existing standard sheets of the United Provinces has been prepared by the Superintendent of Provincial Surveys, and has been supplemented by excellent summaries made by the Board of Revenue and the Director of Land Records. These will be found in Sections VI and VII of this volume; and it is unnecessary here to do more than state the method by which the mapping of each class of districts referred to in these papers can best be dealt with.

66. The three districts of Allahabad, Fatehpur and Cawnpore may be excluded from the estimates altogether, as they have recently been topographically surveyed by No. 14 Party on the 2" scale. Their area is 6,830 square miles.

67. An entirely new survey will be necessary in the Native State of Tehri Garhwal, area 4,180 square miles, where there are no 1" maps. The cost may be estimated at Rs. 30 per square mile. A portion of Etawah may possibly also require a new survey, but part of the district has recently been cadastrally surveyed and it will not substantially affect the estimates to class the whole as requiring only supplementary survey.

68. The standard sheets of Bijnor, Budaun and the nine southern districts of Oudh, Hardoi, Sitapur, Unao, Lucknow, Rae Bareilly, Fyzabad, Sultanpur, Partabgarh and Barabanki are based on old revenue surveys of an earlier date than 1870, and the changes, since the maps were prepared, in the matter of roads, railways and extensions of cultivation have been numerous. The Oudh Revenue Survey, on which the existing standard sheets of the nine southern districts of Oudh are based, was pronounced at the time by the Surveyor General to be a particularly good one, but the recent operations of No. 14 Party have fortunately enabled an examination of its accuracy in topographical details to be made in the extreme south of the Province; and have left no doubt that the revenue surveyors did not consider it necessary to delineate the natural features with the accuracy now required. Captain Crosthwait estimates that the cost of revising the old maps would be as great as that of re-surveying the country; but the operations required will not be so expensive as an entirely new survey, since triangulation and traversing can be to some extent dispensed with. For the districts of Bijnor and Budaun there is no equally definite information, but it will be safe, having regard to the date of their survey, to place them in the same category. The total area of these 11 districts is 19,392 square miles.

69. The hill districts of Naini Tal, Almora and Garhwal were surveyed topographically on the 1" scale between 1867 and 1886, and Captain Coldstream states that on the whole the maps require little correction. His opinion is, however, based on his knowledge of sheets in the lower hills; and it is in evidence from Mr. Watts, who has used the maps up to the Tibet boundary, that the maps of the higher ranges are not equally accurate, while it is clear from an inspection of the maps themselves that they were much more roughly prepared. The correction on any system of these maps, with the addition of heights in sufficient numbers to make them of use to

engineers and others, will be expensive, and the work must be classed a re-survey rather than revision. The area is 13,703 square miles.

The rates of re-survey may be roughly estimated at Rs. 30 per square mile in the hills and Rs. 25 in the plains districts.

70. In 24 districts the existing maps are based on cadastral surveys made either by entirely professional parties or by patwaris working under professional supervision. As the surveys have been made at very various dates extending from 1871 to the present time, the material is necessarily of very different quality. The later surveys have been very carefully carried out, and in some cases such natural features as ravines have been surveyed in much detail by the patwari surveyors. But in the earlier surveys less attention was paid to topographical features, and, apart from this, the changes that have occurred since survey, are in some cases extensive, and a good deal of revision will be necessary. The districts in which a supplementary survey will or should be sufficient, are the following, in all of which there have been cadastral surveys during the last ten years :—

Supplementary survey required.		either by entirely professional parties or by patwaris working under professional supervision.	
	Sq. miles.		Sq. miles.
Lalitpur	1,050	Etah	1,731
Bareilly	1,591	Farrukhabad	1,719
Pilibhit	1,373	Mainpuri	1,697
Shahjehanpur	1,747	Kheri	2,903
Azamgarh	2,147	Gonda	2,819
Jalaun	1,477	Bahraich	2,657
		Rampur	890

the total area of which is 23,879 square miles.

The districts of older date, the cadastral surveys in which were made at various times between 1871 and 1888, and in which the work might be classed either as revision or as supplementary survey, are the following :—

	Sq. miles.		Sq. miles.
Moradabad	2,303	Jaunpur	1,551
Muttra	1,457	Bonares	1,009
Agra	1,856	Ghazipur	1,391
Hamirpur	2,289	Ballia	1,249
Banda	3,061	Gorakhpur	4,596
Jhansi	2,528	Basti	2,753

with a total area of 26,043 square miles. Of these districts it will probably be better to class Muttra and Agra as requiring revision.

71. The Meerut district might have been added to the number of those requiring a supplementary survey only, as it has recently been cadastrally surveyed, and the maps prepared by the patwaris have in a part of the district been reduced as a preliminary to a supplementary survey. But in the portions of this district where such reductions have not yet been made, it will probably be simpler to revise the old topographical sheets direct and a similar procedure must be followed in the districts to the north and south, in which there has been no recent cadastral survey. The maps of Meerut and the adjoining districts of Dehra Dun, Saharanpur, Muzaffarnagar, Bulandshahr and Aligarh and of Mirzapur are comparatively modern, being based on topographical surveys conducted between 1875 and 1884, and they may be classed as requiring revision only. The area of these seven districts is 16,522 square miles.

Revision required.

72. The probable cost of revision and of supplementary survey in this Province has been carefully examined, and Captain Coldstream has furnished very detailed estimates of the different processes involved, which, however, he desires to place on record are necessarily conjectural. Where cadastral maps exist, there can in the plains districts be no question as to the economy effected by utilizing them in place of making a fresh survey. The cost of compiling in office a standard sheet from the cadastral maps does not amount to more than Rs. 3 or Rs. 4 per square mile, and to this has only to be added the cost of supplementary survey in the field. There are no data on which to estimate the cost of this work, but in all flat districts it should be low. In the more broken country in the south of the Province, the work will be more difficult, and where the surveys were of old date, there will be a considerable number of changes to be entered. Allowing for all these considerations, there will probably not be much difference in the expense of supplementary and of revision work in this Province and the cost may be provisionally estimated at Rs. 12 per square mile throughout.

The total amount of work to be done is therefore :—

			Square miles.		Rs.
Survey	...	...	4,200	@	30
Re-survey	...	...	{ 18,700 (hills) @		30
			{ 19,400 (plains) @		25
Revision	...	...	19,800	}	@ 12
Supplementary survey	...	...	48,300		
Not requiring immediate revision		...	6,800		

and the total cost may be estimated at about Rs. 18,10,000.

73. In the United Provinces arrangements have from a very old date been made by the Board of Revenue, independently of the Survey Department, for the supply to district officers of the maps that are absolutely necessary for the purposes of administration. At one time the work was done in the Board's office, at another the assistance of the Survey Department was obtained; more recently, the publication of such maps has been arranged for at the Thomason College, Rurki. These appear to have been prepared by reducing and joining together the village maps made at the time of Settlement. The reductions were first combined to form tahsil maps on the scale of one mile to one inch, and from these again district maps on the $\frac{1}{2}$ " scale were prepared. All the maps show village boundaries, and in addition, a map on the scale of 4 miles to an inch has been prepared for each district locally. It may happen that a district has two $\frac{1}{4}$ " maps, one prepared locally, and another by the Survey Department from the Indian Atlas sheets. The maps so provided vary much in style and quality. The tahsil maps are very rough; they appear to have little pretension to strict geographical accuracy; they are useless for the purposes of the engineer, and the addition of vernacular names has often a confusing effect. The district maps on the $\frac{1}{2}$ " scale are convenient in providing wall-maps of a reasonable size for each district, and they can be roughly kept up to date in the matter of roads. The $\frac{1}{4}$ " maps are convenient for showing boundaries of parganas and tahsils and the main routes of communication; but some of these locally prepared are badly executed, while the district maps on this scale, taken from the Atlas of

India, are often inconveniently crowded with names of unimportant places. The Board of Revenue question the utility of preparing these $\frac{1}{4}$ " maps, but at present they probably serve some useful purposes. Tahsil maps would be improved by the omission of vernacular names, or by the preparation of a separate vernacular edition if that is necessary; but it would seem very advisable that, when the revisional survey of the Province is complete, these maps should be prepared from those issued by the Survey Department, and not from old settlement material. The extent, to which the locally prepared maps of the Board of Revenue have taken the place of Survey of India sheets in these Provinces, may be judged from the fact that few of the officers, who have replied to our questions, make any reference to the latter. On this point the Superintendent, Provincial Surveys, remarks:—

"Under existing conditions the Civil officers of the Provinces do not as a rule use the standard sheets, and are frequently ignorant of their existence. It would appear from the number of cases that have come within my experience that this is because they do not know what sheets to write for, nor to whom to apply, not because they are unable to appreciate the value of a one inch map. All Military and Civil officers of a certain standing should be entitled to free issues of the standard sheets of their neighbourhood, and should be able to procure additional copies for any reasonable Government purpose. It would lead to a more general use of the sheets, if their issue formed one of the duties of the survey staff in the Provinces. * * * * *

"Many district officers, however, have a partiality for tahsil maps. The best tahsil maps I have seen offer no obvious advantages, not possessed by the standard sheets (except the doubtful one of giving names both in English and Urdu). If it is considered that the inclusion of extraneous areas is a disadvantage, by cutting out the tahsils required from the standard sheets concerned, and mounting them in book form, tahsil maps superior to those in use can be prepared with very little trouble."

BENGAL.

74. In its reply to the Circular of the Government of India, forwarding the report of the previous Departmental Committee on the subject of bringing

Obsolete character of maps.

up to date the topographical maps of the country, the Government of Bengal stated that "all officers are agreed that the old topographical maps are obsolete and inaccurate;" and this opinion is very fully borne out by the replies received by the Committee, and by its own enquiries and examination of existing maps. Though the whole of the Province and the Native States attached to it have at some time or other been surveyed or reconnoitred, and the catalogue of the Survey Department contains a large and, at first sight, very complete list of maps on various scales, yet it may safely be said that no part of India is worse off for up-to-date maps of the country. Even Madras, much of which has never been topographically surveyed, is better supplied with maps that are useful to its administrative officers.

This result is due partly to the fact that the original surveys of Bengal were made at a very early date, and have never been revised, but partly also to the variety of systems followed both in making surveys and in the drawing and reproduction of maps.

75. Before the topographical maps are dealt with, it may be mentioned that in many districts portfolios still exist of the $\frac{1}{4}$ " maps of the old revenue survey, which have never been published. These maps are distinct for each village.

Four-inch revenue maps.

They are in some cases beautifully executed, and, though often fifty years old, are still found useful by district officers in the settlement of boundary disputes, and even by engineers in connection with irrigation projects. In a considerable part of Bengal such topographical maps as now exist, are based on these old 4" surveys:

One inch maps in Behar.

76. The map of Bengal on the 1" scale covers 438 standard sheets.

In the extreme north-west of the Province cadastral surveys have been in progress since 1886; and maps on the 1" scale have been prepared by reduction from the 16" village maps. The cadastral work, as described elsewhere, has been executed under professional supervision, and the maps prepared by reduction are admirably suited for administrative purposes, though they have not been revised in the field, and cannot rank as entirely satisfactory topographical maps. There was at the outset some delay in publishing the reduced maps, but, since 1901, 28 sheets (some of them fragmentary) have been published of the districts of Saran, Champaran, Muzaffarpur, and Darbhanga, and arrangements are being made to secure prompter publication in future. A programme has now been submitted by the Local Government to the Government of India for the extension of the cadastral survey to all parts of the Province. It is hoped to complete the cadastral programme in 25 years, and the Committee assume, for the purposes of their report, that effect will be given to the proposals of the Bengal Government.

77. Of the country lying to the east of Darbhanga, as far as Purnea and Bhagalpur, as well as of the districts of the Patna Division south of the Ganges—Shahabad, Gaya, and Patna—no maps in standard sheets are available, but district maps on the 1" scale, without lines of latitude and longitude, have been compiled from revenue surveys of as old a date in some cases as 1841. In the country south-east of Bhagalpur and in Midnapur there are also district maps on the 1" scale reduced from old revenue surveys, not published in standard sheet form, and still another form has been adopted in the case of Krishnaghur, Jessore, and Khulna. In a considerable part of the country near Purulia and Bankura, Dacca and Comilla such maps as exist consist of what are known as main circuit maps, which do not necessarily represent any administrative division of the country.

In Orissa again and in the plains country of Chittagong there have been cadastral surveys, the results of which, after a delay regarding which serious complaints have been made, have been published as standard sheets.

78. While the necessity of accurate maps throughout the part of the country hitherto dealt with is much felt, it will be possible to prepare them cheaply and expeditiously as the cadastral survey proceeds, and the opinion of the Hon'ble Mr. Hare, Member of the Board of Revenue, may be accepted that while "maps correct topographically would be a great improvement, their necessity for administrative purposes is not so urgent as to render necessary any immediate expenditure in anticipation of the re-mapping which will accompany the regular programme of survey and record-of-rights for the Province." As this programme proceeds the topographical maps can be prepared and published after supplementary examination in the field of the reduced maps prepared by the cadastral surveyors.

Supplementary survey sufficient in above tracts.

79. In the south-western part of the Province—in Chota Nagpur and the Native States bordering the Central Provinces—the standard sheets are somewhat more regular, and are as a rule based on somewhat more recent surveys. In some cases it is true that the whole or some portion of a sheet is compiled from very old material, dating back as far as 1841, but most of the maps are the result of topographical surveys on the one inch scale made after 1860 by parties known as—the Bengal survey, or the Chota Nagpur Topographical survey, or the Ganjam and Orissa Topographical survey.

The country covered by these maps is hilly, and it is clear from the appearance of the maps that the hills have been somewhat roughly sketched, and the method of execution and even the symbols used vary from sheet to sheet. Some of the sheets are fragmentary, extending only to the provincial borders, in others a portion has been surveyed by a revenue party, and the topographical map contains only the portion topographically surveyed, the practice of the time being apparently for each party to publish only its own work.

The dates of survey of these maps vary, but range as a general rule from 1861 to 1871. If the delineation of the natural features were accurate, it should be possible to bring them up to date by revision in the field, though the work to be done would be considerable owing to improvement of communications, changes of villages and cultivation, and the necessity of entering heights and levels. There is unfortunately, however, considerable doubt about the accuracy of some at least of the maps. The Superintending Engineer, Northern Circle, Bengal, reports that according to his information the delineation of the hills is entirely unreliable, and the Inspector of Works, Bhagalpur, mentions inaccuracies which he found in the maps in the south of Ranchi, when using them in the course of a survey. The positions of streams and ridges had not been accurately marked, ridges being sometimes a mile or more from their true position, and streams being shown in the map as flowing in the wrong direction. The Superintendent of Provincial Surveys, Bengal, confirms these complaints of inaccuracies, and mentions a case in which a hill has been entirely omitted. The inaccuracies of the maps have also forced themselves on the attention of Settlement Officers.

80. It is impossible, therefore, to assume that these maps can be brought up to date and made reliable by merely revising them on the ground, and even if cadastral maps existed, their use for topographical purposes would be limited. How far the existing maps will prove of use can be determined only in the course of actual survey work. But there can be no doubt that the correction of the maps will involve operations little less elaborate than a completely new survey. Some assistance will be obtained from the old triangulation, but more than this it would be unsafe to count on, and the operations must be treated as re-survey.

81. The standard sheets of the Darjeeling District are based on surveys made on the scale of 4" or 2" to a mile in 1861-62 and 1880-81, and there are a number of other maps in use, all of which are in one respect or other

One inch maps in Chota Nagpur and Tributary Mahals.

One inch maps in other hilly tracts.

unsatisfactory. In the most recent edition of the standard sheets, published in 1893, the hill shading is very dark, and fails altogether to give an accurate idea of the relative height of the hills. Few heights are marked, and few, if any, levels given. A re-survey will be necessary to produce a satisfactory map of this district.

For the State of Sikkim, and for the hilly country west of Orissa, the only maps are on the $\frac{1}{2}$ " scale. The Sikkim maps belong to the North-East Frontier series, and are based on somewhat rough reconnaissance surveys, with additions from the larger scale surveys of the Darjeeling District. The maps are very inferior, and are briefly pronounced by the Political Agent to be of no use for administrative purposes. If maps of this country are to be provided at all, a new survey is indispensable.

The $\frac{1}{2}$ " maps of the hilly tracts west of Orissa have been prepared from materials of various periods, dating back to a topographical survey of Orissa and Ganjam in 1859. Some parts have been enlarged from surveys on the $\frac{1}{2}$ " scale, others reduced from the 1" scale. A small portion of the country has been cadastrally surveyed. The provision of new maps cannot be regarded as urgent, but a fresh survey will at some time be indispensable. Of Hill Tipperah and the Chittagong Hill Tracts only $\frac{1}{2}$ " maps exist. There has been no regular survey of these tracts.

52. Leaving aside the question of cadastral maps, the great mass of opinion in Bengal is in favour of the provision of maps on the 1" scale for detailed work, and of maps on the $\frac{1}{2}$ " scale for general purposes. The Local Government would be glad to have maps on the 2" scale in tracts irrigated by canals, and Mr. Harcourt expressed a doubt as to the possibility of accurately delineating topographical features on a small scale as the 1" in parts of Eastern Bengal. Some opinions have been expressed in favour of a $\frac{1}{2}$ " map for Local Boards, the 1" scales being found to be too small. These maps are being issued as the cadastral surveys proceed, and there will undoubtedly be of great use for administrative purposes and for distribution to local officers. The Local Government proposes to issue them in future on the $\frac{1}{2}$ " scale. The insertion of village boundaries is everywhere considered essential by the civil officers; and in this Province it is considered of importance to show the boundaries of the revenue *manzils* as they originally existed.

53. On the assumption that the programme of cadastral survey in Bengal is carried out, a rapid and inexpensive supplementary survey is all that is necessary to allow of the compilation of good topographical maps from cadastral materials in the level plains of Bengal, that is, in the country between the Himalayas and the hills of Chota Nagpur, and between Acom and the sea, as well as in Orissa and in such tracts of Chittagong as have been cadastrally surveyed.

In Chota Nagpur, on the other hand, and in the south of the Province generally, with the exception of the cadastrally surveyed parts of Orissa, much of the country is hilly or covered with forest, and here the cadastral maps will be of comparatively little assistance. Similarly in the Southal Pargannas, where the cadastral survey is being carried out by the Settlement Officer with a local staff, the cadastral maps require extensive re-survey to make

them suitable for topographical purposes. In all those districts it is true that some assistance may be obtained from the cadastral maps, when they are prepared, but it is impossible to estimate its extent, and in some parts the topographical survey must be entirely independent of the cadastral.

84. The area falling under each class of work to be done and the probable cost-rate of the operations are as follows:—

Estimate of cost.

- A. New survey—26,400 square miles—at Rs. 40 per square mile.
- B. Re-survey—49,700 square miles—at Rs. 35 " "
- C. Supplementary survey—120,300 square miles—at Rs. 10 per square mile.

The division which is shown in the index map is necessarily not absolutely exact. In some of the tracts falling under class C, as for instance the south of Gaya, a certain amount of re-survey or even of new survey will be necessary, while there are tracts in class B, where considerable assistance may be derived from the cadastral maps. But for the purposes of our estimate the classification is sufficiently close: and it would be impossible to go into further detail without a minute examination of the class of country in different parts of each district. The total expenditure in providing a 1" map of Bengal should not exceed 40 lakhs.

85. As compared with some other parts of India, the requirements of Bengal are not urgent, and the tracts in which a new survey is required are so low in the order of urgency, that it is only for the sake of completeness that we think it necessary to enter them in the programme. The maps prepared by the Superintendent of Provincial Surveys are so good, that only a very slight revision is necessary to see that roads are correctly classified and that important natural features have not disappeared in the course of reduction. A low rate for the work has therefore been taken.

Work not urgent.

86. Of the Atlas sheets for the Province 12 full sheets and 13 quarter sheets were examined by the Committee. The full sized sheets were all engraved in London, as well as a number of the quarter-sheets, the remainder of the latter being engraved by the Survey of India. The sheets are admirably engraved, but the maps are based on old surveys. They are too closely crowded with names, and the spelling employed is antiquated. From the Atlas sheets district maps on the same scale have been provided. These will now be replaced by the "degree" sheets.

Small scale maps.

Divisional maps on the $\frac{1}{8}$ " scale have been prepared for most of the divisions. These are very rough photozincographed maps, often little more than outlines, and showing little topographical detail. For Orissa there is in addition to the outline map an engraved divisional map on the $\frac{1}{12}$ " scale, a well-executed map, though, of course, not up to date. For the Rajshahi Division there is a map on the $\frac{1}{16}$ " scale as well as on the $\frac{1}{8}$ ", and Chittagong has a rough outline map on the scale of $\frac{1}{4}$ ".

Outline district maps on the $\frac{1}{8}$ " scale have been published for a number of districts, and there are provincial maps on the scale of $\frac{1}{16}$ ", $\frac{1}{32}$ " and $\frac{1}{64}$ ".

32°

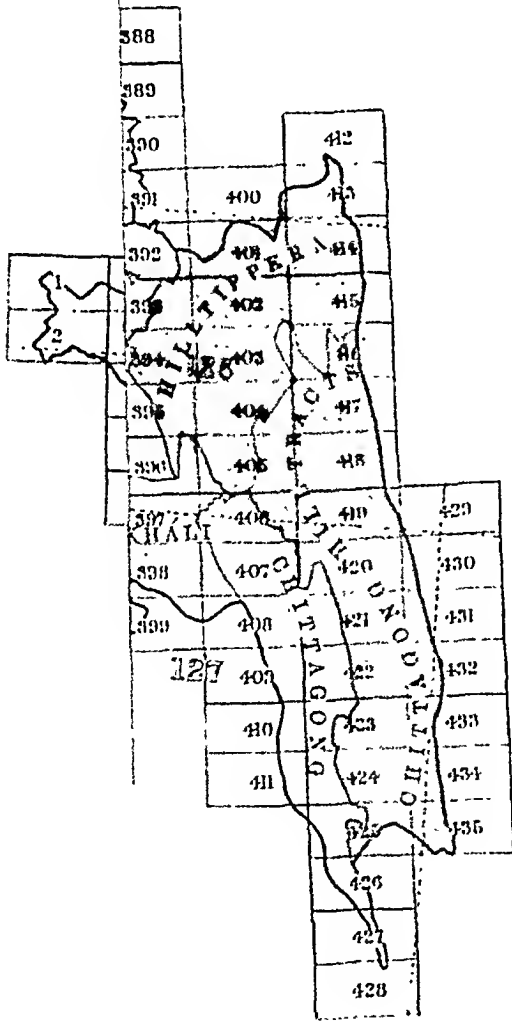
33°

NOTES

Universal 1, 2, 3, 4 4" divide the new series of consecutive numbers and in the Sheets of Standard area, via 35' Latitude by 30' Longitude a Scale of 1 inch = 1 Mile.
Open figures and lines in here represent the numbers and limits of the real Sheets of the Indian Atlas on the Scale of 1 inch = 4 Miles

Class of Work to be done.

Survey.....	<input type="checkbox"/>	26,400 Sq. miles.
Resurvey.....	<input type="checkbox"/>	49,700.
Supplementary Survey..	<input type="checkbox"/>	120,300.
Total		196,400 Sq. miles.



ASSAM.

87. In Assam there is the same difference of system as in Bengal in the method in which various parts of the Province have been mapped. In the plains country of the Surma and Assam Valleys revenue surveys on the 4" scale were carried out between 1860 and 1875, and were used for the compilation of maps on the scale of 1"=1 mile. In the Assam Valley these maps were prepared in standard sheet form, but for each district separately, each series of maps showing one district only, and the border sheets of each district being incomplete.

In parts of two districts,—Goalpara and South Sylhet—there have been subsequent topographical surveys (executed on the 2" scale) between 1873 and 1883. In Goalpara the results have been published as standard sheets on the 1" scale, while in South Sylhet they have been published on the 1" scale, but not as standard sheets. More recently the cultivated portions of the Brahmaputra Valley, and small portions of Sylhet and Cachar have been cadastrally surveyed on the 16" scale, and the work of reducing these maps by pentagraph and fair drawing them on the 2" scale for reduction by photography to the 1" scale, is now proceeding, and has been brought nearly up to date. It may be noted, however, that these cadastral surveys rarely extend to a complete standard sheet. Many of the new sheets consist of a few scattered patches of cultivated land, and maps prepared from them and showing these areas only, are of no practical use. More recently the plan has been adopted of filling up the blank spaces on these sheets from the old maps, the details of the old surveys being printed in brown. For the Khasia and Jaintia Hills there are two sets of maps. A portion of the area round Shillong, covering six complete standard sheets and portions of two others, was surveyed on the 1" scale at different dates between 1864 and 1879, while the remainder has been mapped on the $\frac{1}{2}$ " scale only, as the result of rough surveys on this scale made between 1866 and 1874. The Garo, Naga and North Cachar Hills and South Sylhet have similarly been roughly surveyed and mapped at different dates between 1878 and 1880. The north-western and south-eastern parts of Manipur were reconnoitred at the same time and on the same scale, but of the rest of that country and of portions of the Naga Hills, and the country occupied by the Miris, Daplas and Mishmis only $\frac{1}{4}$ " reconnaissances exist.

Of the Lushai Hills to the south a portion, covering 4 standard sheets, has been surveyed so recently as 1897-1901 and published on the 1" scale in 1900-02, but only rough reconnaissance maps on the $\frac{1}{4}$ " scale exist of the remaining portions of these hills.

88. As regards the quality of these maps it may be said generally that, with the exception of the recently surveyed tracts in the Lushai Hills, and of the portions of districts where fresh cadastral work has been carried out, there are no topographical maps of Assam with any pretensions to being up to date. The maps of Cachar and Sylhet are admitted on all sides to be useless, and the Chief Commissioner considers a new map to be so urgently required in Sylhet that he recommends that the work be taken in hand in anticipation of the cadastral survey, which will probably be made of this district in a

few years. Of the maps in the Brahmaputra Valley the following opinion expressed by a District Officer is concurred in by others, and is very fully confirmed by comparisons between old maps and recent cadastral surveys of the same areas :

"The existing 1" and $\frac{1}{4}$ " maps of the district are of very little practical value. There are no $\frac{1}{2}$ " maps in my office. The 1" and $\frac{1}{4}$ " maps are very incomplete in many respects, and from them very little information can be gathered as to the actual character of the country. This defect would not appear to be altogether due to any defect in the original preparation or in the drawing of the maps, although in some cases there would appear to be defaults in this respect. But these maps have lost their practical value, mainly owing to changes in topography. The face of the country has been greatly changed since 1875. Jungle has given place to cultivation, and tea gardens now occupy many areas of former waste. Rivers have changed their courses considerably, and with them the roads and ferries in the neighbourhood. The opening of tea gardens has resulted in the construction of many new roads, and sanitary improvements have added many tanks which do not appear on the maps. Railways, police outposts, and rest-houses have all been established, and *manzars* have been amalgamated since the last survey was made. As a guide to the district, and as a map thereof, these maps are of little practical value. They afford no real clue as to the character of the country, and a stranger to the district, guided by these maps would be somewhat at sea."

Owing to their patchy character the cadastral surveys are of little value as the basis of new topographical maps, and even since these latest surveys, in many cases the face of the country is said to have been entirely changed owing to—(1) the earthquake; (2) the desertion of villages on account of *Kala-azar*; (3) the construction of the railway.

Of the maps of the hilly tracts those recently made of the Lushai country on the 1" scale are on all hands admitted to be excellent, and require but to be kept up to date. The drawing is good and the heights are carefully and fully marked. The best of the others are the 1" maps of a portion of the Khasia and Jaintia hills, which however contain but few heights, and are not drawn so as to show the character of the hills satisfactorily. They require to be thoroughly revised in this respect as well as in the delineation of village sites, and of roads and paths and in the spelling of village names. These maps will require a considerable amount of revision, though a completely new survey will not be necessary, and the work may be classed as re-survey. The maps of the remaining hill tracts cannot be regarded as satisfactory topographical maps in any sense of the word and a fresh survey will be necessary.

89. The inconvenience caused by the absence of good maps, especially in hilly tracts, is much felt in the Public

New maps required.

Works Department. The existing maps

give insufficient information as to heights, while village names and sites have changed and very considerable inaccuracies have been detected in the location of places of comparative importance, such as Dimapur. Great difficulty was experienced in laying out the road from that place to Kohima, and a large amount of survey was entailed on the officers carrying out the work, which would have been unnecessary had good maps on the 1" scale been available. A smaller scale would not be of much use even in the hill tracts.

From the military standpoint there are no maps of Assam of any use for tactical purposes, except the four recently prepared standard sheets of a part of

the Lushai country. Elsewhere the maps are either so hopelessly out of date, or so wanting in topographical detail as to be tactically useless. For strategical purposes the $\frac{1}{2}$ " Atlas sheets are available, but are too much out of date to be reliable.

90. The Chief Commissioner considers that the most urgent requirement of his province, for administrative purposes, is the provision of good topographical maps for Sylhet and Cachar, portions of which have already been cadastrally surveyed. Next to these surveys in order of urgency he would place the survey of Manipur and of the Naga hill tracts in the eastern frontier, tracts for which maps are constantly required, especially of the hitherto unsurveyed country added to the district in 1904. The Manipur State would, he thought, be prepared to meet the cost of at least the survey of the low-lying tracts to the extent of say Rs. 50,000. It appears open to question whether the survey of Manipur and the adjoining tracts should not be considered the most urgent requirement of this Province. In Sylhet and Cachar it is possible that some years hence the necessary material for 1" maps may be available from cadastral surveys. Of Manipur and the hilly country beyond and north of it, no such material will be available; the maps are required for military as well as administrative purposes, and the construction of the Assam-Bengal Railway has opened out the country, and has added to the necessity for a reliable map.

Of the country in the Brahmaputra Valley good maps would be of great value for ordinary administrative purposes, and it is advisable also that for military purposes the whole tract along the northern frontier of the province should be carefully mapped.

The survey of the remaining parts of the Province—the Garo Hills, portions of the Khasia and Jaintia and Lushai Hills and other hill tracts—may well stand over till the rest of the work is completed.

91. Survey work in Assam is expensive owing to the climate, the foggy weather, the character of the country, and the necessity of importing labour. Estimate of cost. In the Lushai Hills the rate of a 1" survey was about Rs. 100 per square mile; but the country was exceptionally difficult, and much of the work should be done at a much lower rate if a systematic programme be adopted. The index map shows the portions of the province in which fresh survey and re-survey appears necessary, and the probable cost of the work (omitting the four sheets of the Lushai country, already published on the 1" scale) may be estimated as follows:—

Survey—38,200 square miles at Rs. 40.	Rs. 15,28,000.
Re-survey—21,500 square miles at Rs. 30.	Rs. 6,45,000.
Supplementary—9,400 square miles at Rs. 20.	Rs. 1,88,000.
Not requiring immediate revision—2,200 square miles.	

Should the cadastral survey of Cachar and Sylhet be completed before the topographical work commences, some reduction will be possible in these figures, as the area of supplementary work will be increased. For the present the cost of the survey work to be done in Assam may be estimated at 23½ lakhs.

92. Some minor points in connection with the Province require notice. The

Village boundaries.

new topographical sheets lately issued are complicated by the entry of "village"

boundaries and of the boundaries of tea-garden estates. The "villages" of the Assam Valley have no existence apart from the cadastral survey, each merely representing a block of country which could conveniently be included in a single cadastral sheet. A "village" may include two or three collections of houses, each bearing a different name. The entry of these boundaries is in the Chief Commissioner's opinion quite unnecessary, nor is there any necessity to show on topographical maps the boundaries of tea estates, the areas of which are gradually being expanded. The limits of blocks of cultivation should, however, in the Assam Valley be shown, and the boundaries of what are in Assam known as *mauzas*, which correspond roughly to *parganas* elsewhere, are required for administration purposes.

93. There are no systematic arrangements in this Province for the preparation

Locally prepared maps.

locally of special maps on the 1" or similar scales; but district and settlement officers occasionally have rough plans made for their own use, to supplement the Survey maps.

BURMA.

94. The earliest surveys of Burma, if they can be so called, and the only

Early surveys.

surveys from which the maps of the country as a whole have been prepared

were of the nature of rough reconnaissances or explorations made as occasion offered, when the opportunity presented itself of attaching surveying parties to military or police expeditions. From the material so obtained maps have been prepared on the $\frac{1}{2}$ " scale for Lower Burma and on the $\frac{1}{4}$ " or $\frac{3}{8}$ " scale or both for Upper Burma, and these are published as maps of the North-East and South-East Frontier Series. These maps which extend to the country far beyond the northern and eastern boundaries of the Province are necessarily incomplete and sketchy and are frequently compiled from material of very old date—as far back as 1853 in some cases. New editions are published when fresh material becomes available, and in the parts of Upper Burma where no 1" maps exist, the $\frac{1}{4}$ " maps are found to be of considerable use. The $\frac{1}{2}$ " maps of Lower Burma are on too small a scale to be of service for any purpose, except as rough index maps, and as they are in these parts more out of date than elsewhere they need scarcely be taken into account.

95. In tracts of which a 1" survey has been completed, the Survey of India

Degree sheets.

are publishing preliminary editions of the degree sheets on the $\frac{1}{4}$ " scale prepared by

the zincographic process. These degree sheets will eventually be engraved.

96. As a rule no small scale district maps have been published for Burma,

Small scale maps.

but an exception has been made in the case of the following districts for which

$\frac{1}{4}$ " maps have been prepared, based on surveys of the dates noted opposite each:—

Katha	...	...	...	...	...	1892-93
Ruby Mines	...	...	...	...	...	1893
Minbu	...	...	...	...	...	1888-89
Akyab	...	...	...	...	...	1853-61

and divisional maps of Pegu and Tenasserim on the same scale, and compiled from very old material, have also been published.

97. The survey of the Province on the one-inch scale is now steadily proceeding, but the material and the methods employed vary in different parts. In all

One-inch maps.

districts in which there is much cultivation, the cultivated area has been or is being mapped on the 16" scale either by cadastral parties of the Survey of India, or by special parties employed by the local Land Records Department. With one important exception, the original cadastral surveys were all done directly by the professional Department, and the cadastral maps have been reduced by pentagraph to the 2" scale, and further reduced by photography for incorporation in the 1" standard sheets. At the outset these reductions were used without any further survey to supplement the deficiencies of the cadastral survey in topographical detail; and it is no doubt owing as much to this cause as to their being now somewhat out of date, that maps of portions of the Irrawaddy Delta in Lower Burma are described as less satisfactory than others. It soon became clear that in a country like Burma mere reductions from cadastral survey would fail altogether to provide a map of the country and it was decided therefore to have the reduced maps carefully revised by topographical surveyors, before issue to the public. Two parties have for some time been employed on this work—No. 3 since 1899-1903, and No. 10 since November 1896. The work of the surveyors of these parties is partly purely topographical, where portions of standard sheets have been left entirely blank by the cadastral surveyors, and partly supplementary, where it is necessary only to go over the ground included in the cadastral map. Much of this supplementary work, however, as the Committee had an opportunity of seeing, is little less laborious than new survey. The work is at present being done in the field on the scale of publication, *i.e.*, the one-inch scale.

The greater portion of the Province, however, lies outside the cadastral area. A considerable part of this has been declared reserved forest and will, if existing arrangements are maintained, be topographically surveyed on the 4" scale by the Forest Surveys, one party of which along with several detachments is now employed in the Province.

In addition to these parties, whose topographical outturn depends wholly or partly on reduction from larger scale surveys, there were till lately two topographical parties employed in the Shan States which surveyed directly on the 1" scale. In the present year the last of these parties has been moved, with the consent of the Local Government, to undertake more pressing work in Baluchistan.

98. The existing 1" maps in Burma are, with the exception of those in Baluchistan, the latest and most up to date

State of the maps.

in the country, and the opinion of local officers as to their value is extremely favourable. The joint opinion of the Financial and Settlement Commissioners and the Director of Land Records, which refers apparently to the cadastrally surveyed districts alone, is that the maps are in good order except in the Irrawaddy Delta where they are based on old material. For Railway purposes they are pronounced to be invaluable, and for Irrigation works essential, though here as elsewhere the Irrigation engineers would prefer a larger scale map (4" by preference,

and, if not, 2"). The opinion of Civil and Forest Officers is equally favourable, and the joint opinion already referred to states that it is most essential to map the entire country on the 1" scale; this view is strongly pressed by the Lieutenant-Governor who would rather dispense with the 4" maps of the Forest Surveys than delay the preparation of 1" maps of the whole country.

99. There is some difference of opinion as to the entry of village boundaries on the 1" maps for administrative purposes. At present the maps show the boundaries of *kwins* by dotted lines, the *kwin* being apparently an arbitrary survey unit chosen for the convenience of mapping, and of importance for revenue purposes. Some officers would prefer to show the boundary of village headmen's circles, and others again think that on the one-inch map all these boundaries are unnecessary.

More levels are asked for in the maps and both Forest and Railway officers note the importance of showing, if possible, the heights of saddles between hills as well as of the hills themselves.

100. It is not altogether easy to estimate the amount of work to be done in Burma to provide the country with a 1" map, both because the frontier is still in some cases indeterminate, and because many of the standard sheets have been completed in part only. The sheets already published, in addition to a few fragmentary ones showing parts of the country near Akyab, Tavoy and Mergui, consist of two main blocks of maps, one in Lower and one in Upper Burma. In Lower Burma the published sheets extend from Moulmein, Rangoon and Bassein to Prome and Toungoo, but many of them contain blanks, and it does not appear that the sheets hitherto published extend over the entire area of any one district in this part of the Province. The Upper Burma series is somewhat more compact, extending from Minbu, Mandalay, and the Ruby Mines on the west up to, or nearly up to, the line of the Salween on the east. A five years' programme has recently been sanctioned for the prosecution of further work, which if carried out will provide the Province with a complete 1" survey of the country along the Irrawaddy from its mouth to Bhamo, except a tract of minor importance in the south and west of the Delta; of most of the country between the Irrawaddy and the sea in Lower Burma; and of a large and compact block between the Irrawaddy and the Salween in Upper Burma. There will still, however, remain an immense area for survey in the south in the Tenasserim Peninsula; in the west from Akyab to the Assam frontier, including the Lower and Upper Chindwin; and in the north and east to carry the surveys up to the Provincial boundaries. The Surveyor-General estimates the area still remaining for new survey at 141,500 square miles, in addition to about 30,000 square miles, chiefly in the Irrawaddy Delta, the maps of which will require a considerable amount of supplementary survey. A small area (2,700 square miles), surveyed some years ago in Mergui will require re-survey.

101. Much of the country in Burma is very difficult and, even if the survey is done on the 1" scale, it would be unsafe to assume a lower rate than Rs. 40 per square mile. For resurvey and supplementary survey the rates may be taken at Rs. 30 and Rs. 20 respectively; the latter rate appears to be justified



by the recent working of the parties employed in the Province, while the former must be conjectural. The estimated cost for the whole of Burma thus comes to nearly 63½ lakhs, the details being as follows :—

Survey	...	...	141,500 square miles at Rs. 40 per square mile.
Re-survey	...	...	2,700 " " at " 30 " " "
Supplementary survey	...	...	29,700 " " at " 20 " " "
Not requiring immediate revision			83,300 " "
Total			257,200 square miles.

102. The excellent organisation for survey purposes of the Land Records Department in this Province has allowed of much work being done to supply the local officers with compilations from the survey maps, which are of great administrative convenience. For most, if not for all districts, maps on the $\frac{1}{2}$ " scale have been prepared by reductions from the 1" sheets supplemented where such sheets do not exist by enlargement from the $\frac{1}{4}$ " maps. These are rather skeleton plans than maps, but are of use to administrative officers, showing as they do the principal towns and villages (without boundaries), the roads and rivers, and the approximate position of hilly tracts, while it is possible to keep them roughly up to date. In some cases 1" maps of subdivisions or 2" maps of townships have also been prepared, the basis of the maps being always as far as possible the standard sheets of the Survey Department. Arrangements for reproducing these maps by lithography or the Vandyke process are provided by the Government Press at Rangoon.

THE ANDAMAN AND NICOBAR ISLANDS.

103. A topographical survey of the South Andaman Island was ordered by the Government of India in August 1883, and it was subsequently decided to extend the survey to the remainder of the Andaman Islands. The work lasted three years by which time the North, Middle and South Andamans with the adjacent small islands were surveyed; in the Little Andaman Island the hostility of the savage inhabitants prevented the survey of more than about one-third of the area lying on the north side of the island. In the following year, 1886-87, the twenty small islands which form the Nicobar group were surveyed, their total area being found to be 678 square miles.

The only available datum on which to base the survey being the position of a point on Obatham Island, the latitude and longitude of which had been astronomically fixed by the Great Trigonometrical Survey in 1863, a base line about 960½ yards long was measured on the rifle range in Navy Bay at Port Blair, and on this the triangulation was based. The general survey of the Islands was executed on the $\frac{1}{2}$ " scale. A portion of the South Andaman Island surrounding Port Blair, and the environs of the Settlement of Kamorta in the Nicobars, were however surveyed on the 4" scale, to assist the further development of the Settlements. The two small volcanic islands of Nareendam and Barren Island were surveyed on the 8" scale.

The total amount of work done and its cost are shown below:—

Season.	Triangulation.	Survey on the scale of			Cost.
		8"	4"	2"	
Andaman Islands.	1883-84 Sq. m. 928	6	28	...	Rs. 22,358
	1884-85 1,000	...	111	670	„ 40,567
	1885-86 955	...	28	1,464	„ 27,540
Nicobars	1886-87 678*	...	6	678	„ 39,000
Total	... Sq. m. 3,561	Sq. m. 6	Sq. m. 173	Sq. m. 2,812	Sq. m. 1,29,471

* A large expanse of sea was covered by the triangulation; the area given is that of the actual group of islands.

The total cost falls at a rate of Rs. 43 per square mile on the areas actually surveyed.

104. The work was extremely arduous and being scattered in a number of

Nature of survey work in the Islands.

hilly islands presented exceptional difficulties. The surveyors had to work in boats and found the islands difficult to approach, a tug steamer, the "Reclaimer," being actually lost in January 1885 through foundering on a hitherto unknown rock. The islands were covered with dense primeval forest with trees 200 feet high, abounding in bamboo jungles and intersected by numberless creeks, with frequent and extensive mangrove swamps. The inhabitants were savages who were in places distinctly unfriendly. The procuring of supplies locally was impossible. Much of the survey work partook therefore of the nature of rough reconnaissance, especially in the Nicobars where again the time at the disposal of the party did not permit of much detailed survey. However the main objects aimed at—the correct delineation of the coast lines of the main islands, and the correct determination of the position of the groups on the earth's surface,—both objects having reference chiefly to the requirements of navigation, were attained.

The 4" survey was particularly laborious as the surveyors had on South Andaman "to cut their way foot by foot through one of the most stupendous forests in the world." The system adopted at Port Blair and at Kamorta to show the hill features, was a modified method of contouring, the contours being obtained with the water-level along the ridges and spurs and the intermediate spaces sketched in by eye, each contour showing a vertical interval of 25 feet apart.

105. The Chief Commissioner of the Islands has been consulted regarding

Survey requirements.

these maps. He has stated that it will probably soon be necessary to make a detailed and careful survey, on a large scale, of the whole of the North Andaman Island, of the northern half of the Middle Andaman Island and of the Great Nicobar Island, if, as is likely, these valuable tracts are opened up to private enterprise. The existing maps of these three islands are, except

MOUNTAIN PANORAMAS

FROM THE

PAMIRS AND KWEN LUN

PHOTOGRAPHED AND ANNOTATED

BY

M. AUREL STEIN, Ph.D., F.R.G.S.



LONDON

THE ROYAL GEOGRAPHICAL SOCIETY, 1, SAVILE ROW, W.

EDWARD STANFORD, 12, 13, AND 14, LONG ACRE, W.C.

1908

INTRODUCTORY NOTE

11: photographic panoramas from the Kwen Lun range south of Khotan, and on
2: Pamirs, of which a selection is here published, date from my journey of
1900-01 in Chinese Turkestan, made under the orders of his Majesty's Indian
Government. They were taken with a Bridges-Lee photo-theodolite, primarily
with a view to supplying photogrammetric materials which would usefully supple-
ment the surveys by plane-table and theodolite carried on, under my direction and
with my assistance, by Surveyor Ram Singh, of the Survey of India Department,
along the routes followed. Subsequent to the publication of the maps embodying
these surveys and of my 'Sand-buried Ruins of Khotan,' in which I have described
for a wider public the main results of my expedition, geographical friends, who
had examined the original records of my photogrammetric survey work, repre-
sented to me the advisability of reproducing a series of my panoramas, on account
of the interest they possessed, from a geographical and geological point of view,
as illustrations of typical features in the orography of those regions.

It was a source of special gratification to me that, with the assistance of a grant
sanctioned by his Majesty's Secretary for India, the Council of the Royal Geo-
graphical Society in 1903 undertook the relatively expensive task of reproducing
and publishing the series of selected panoramas here presented. The work of
preparing positives suitable for reproducing, which was commenced by Mr. H. W.
Simpson, of the Royal Geographical Society's office, towards the close of that
year, has proved a distinctly difficult one. Among the technical reasons for this
it will suffice to mention two of which I have personal knowledge. Owing to the
trying conditions under which the photo-theodolite had to be worked, generally
on great heights and in exposed positions, the taking of a complete round of
accurately levelled photographs with that exact but delicate instrument was a
slow process. Intervening changes in atmospheric conditions and light have thus
often caused the negatives of the same panorama to vary greatly in intensity and
photographic value. The negatives had suffered further from the fact that,
owing to the great pressure at which my archaeological explorations had to be
carried on, and owing to my prolonged camping in the desert, their development
had to be delayed for a long time, in some cases for nearly a year.

The preparation of positives capable of effective reproduction by half-tone
process from negatives affected by these and other deficiencies must have greatly
taxed Mr. Simpson's skill, and I appreciate all the more the patient care and
attention he has bestowed on the work. Though, owing to my absence on the
Indian North-West Frontier, I had no opportunity of examining the finished prints
from which the process-blocks have been produced, I have convinced myself by
a comparison of the latter with my original photographs that no essential feature